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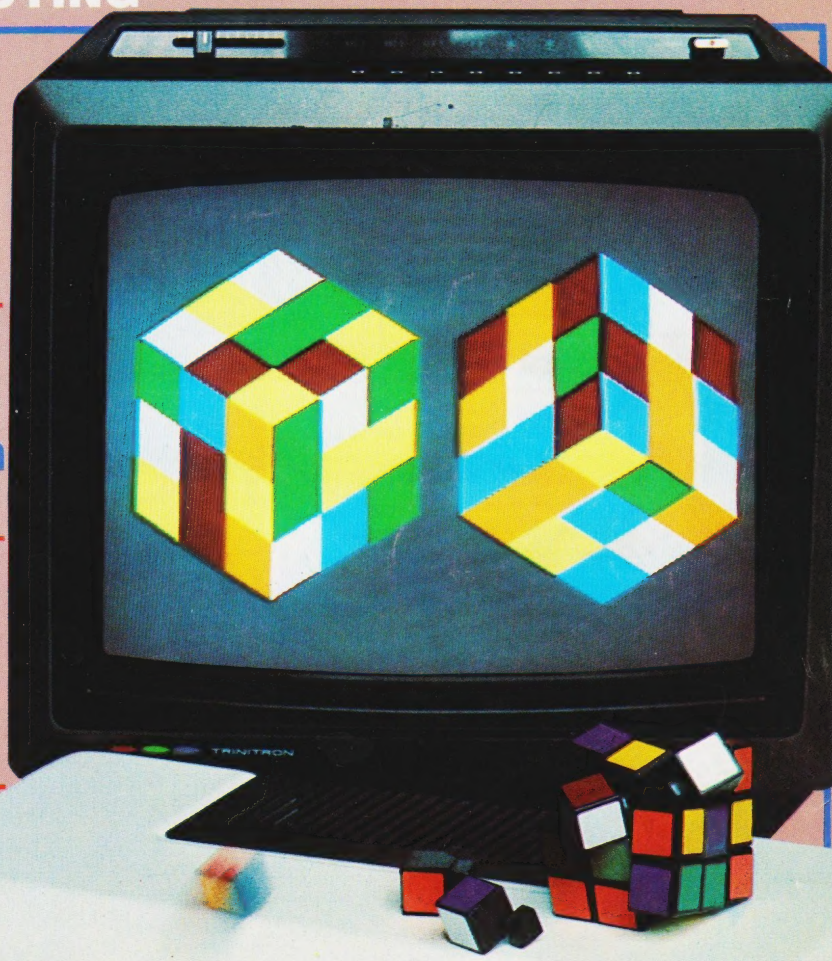

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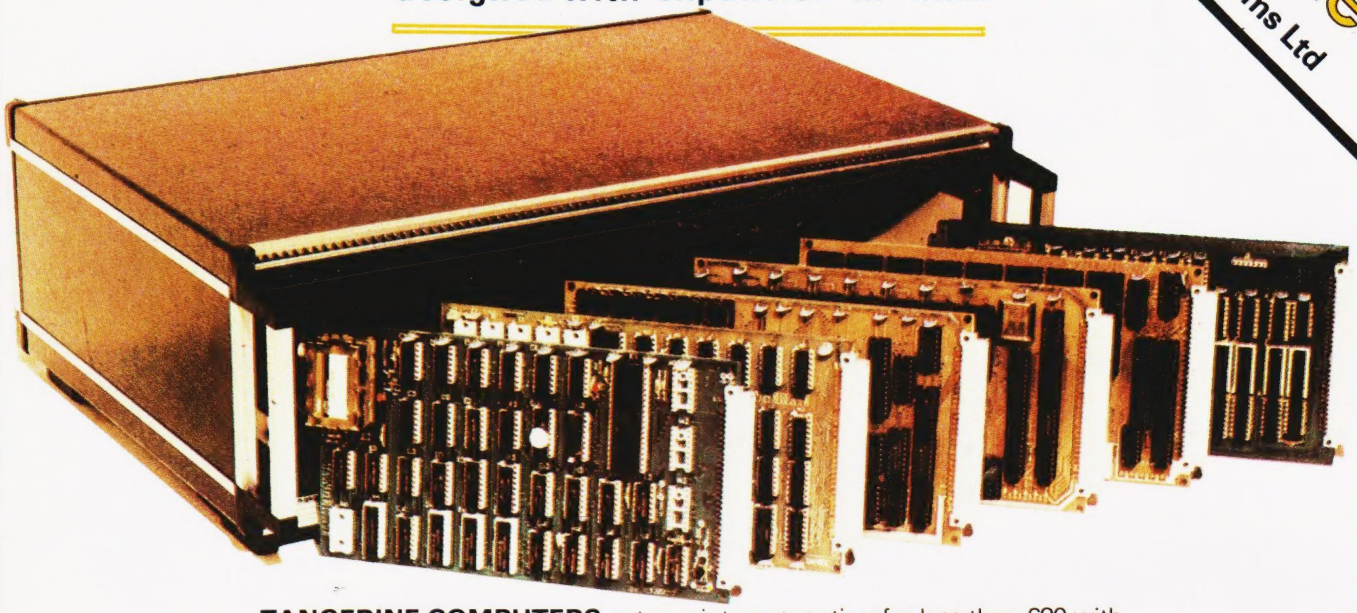

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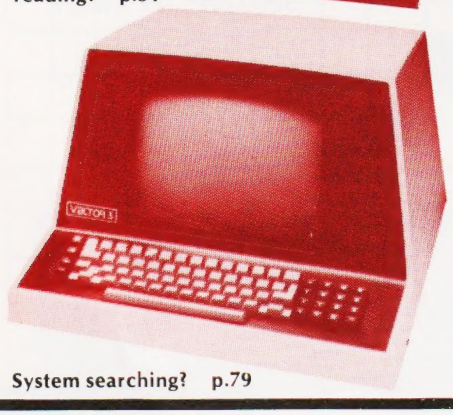

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Computing Today is constantly on the lookout for well written articles and programs. If you think that your efforts meet our standards please feel free to submit your work to us for consideration.

All material should be typed, but neat handwritten copy may be considered. Any programs submitted must be listed, cassette tapes and discs will not be accepted, and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

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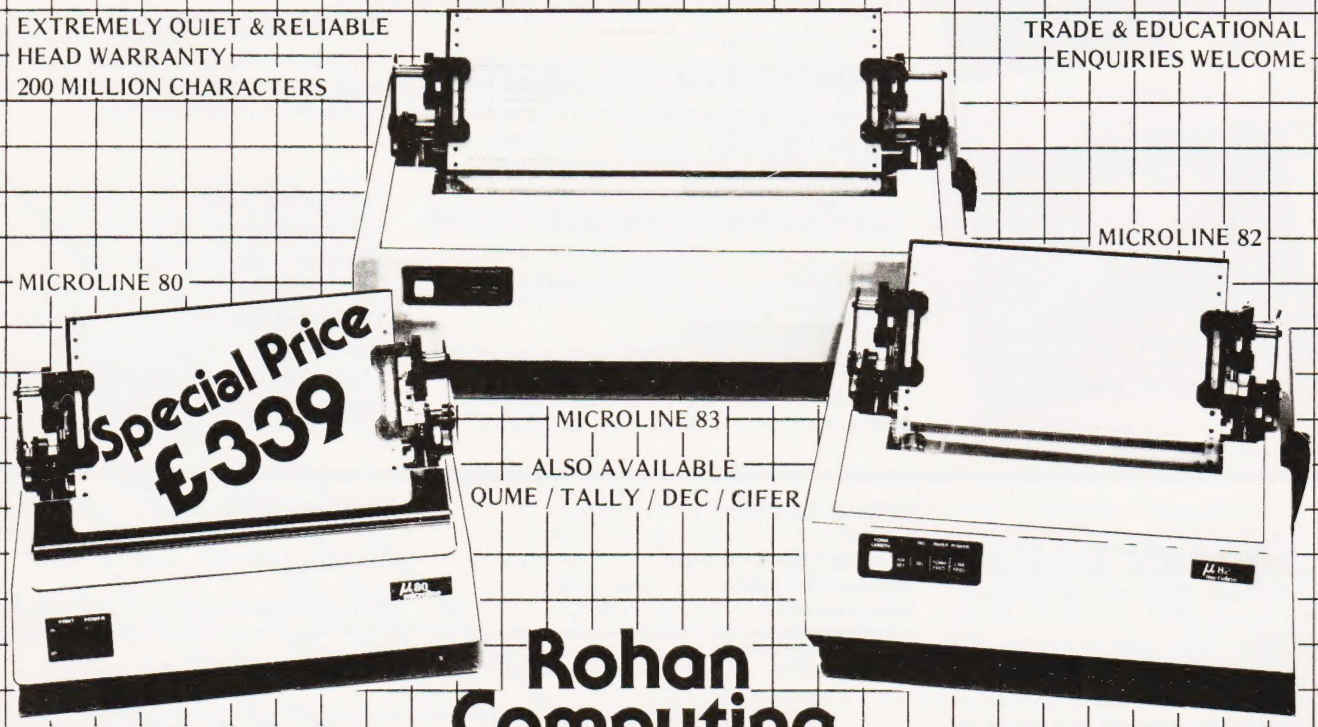

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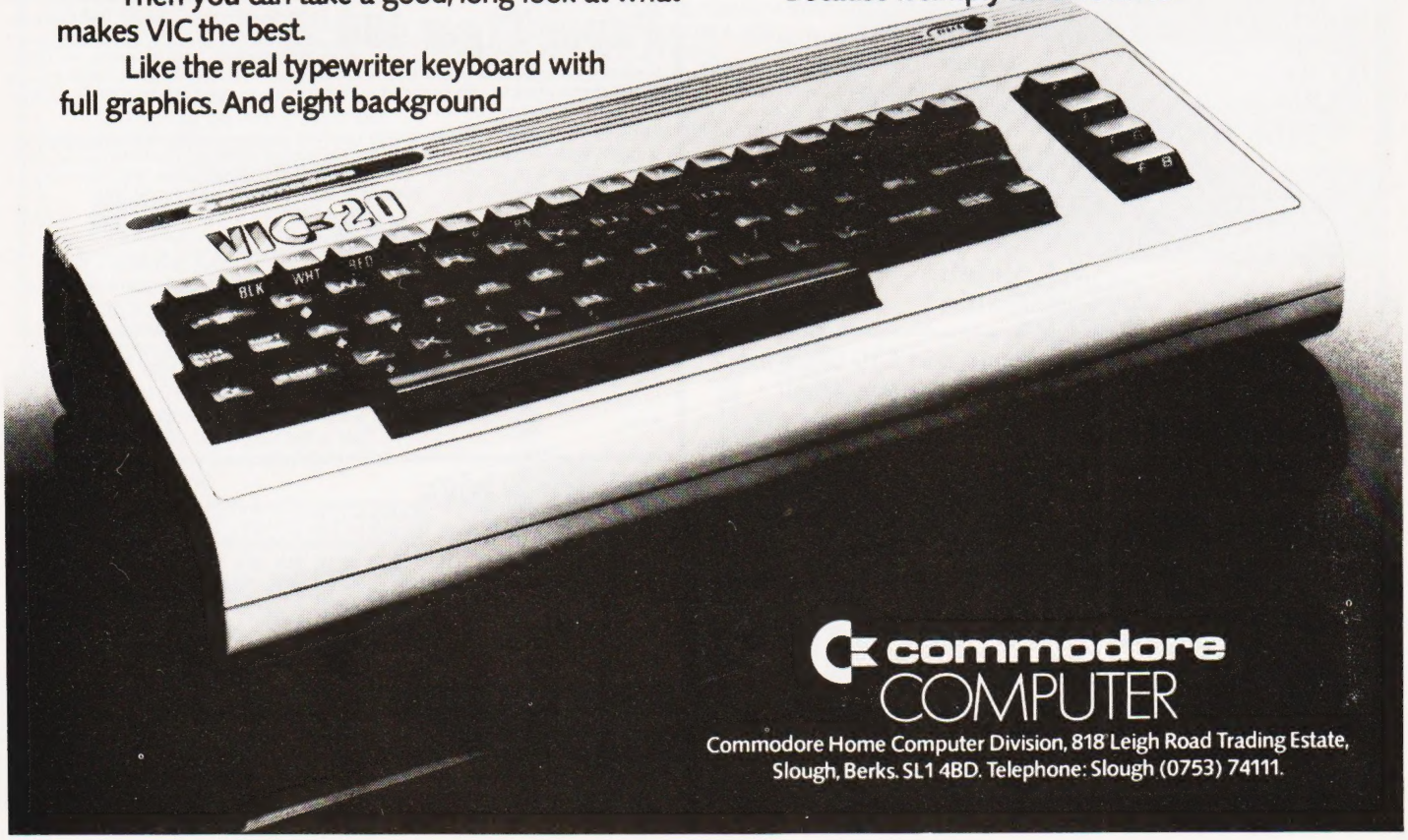

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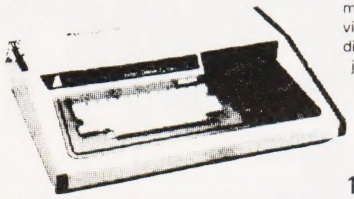

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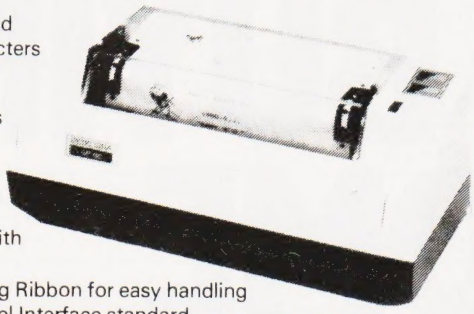

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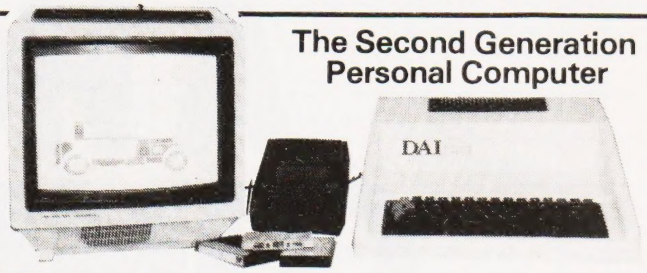

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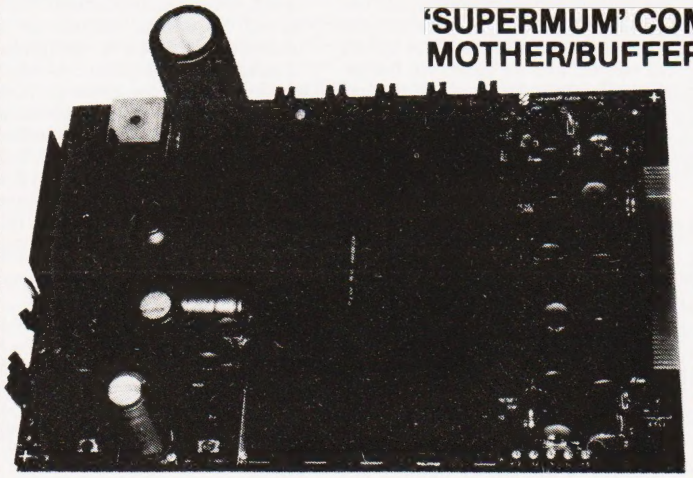

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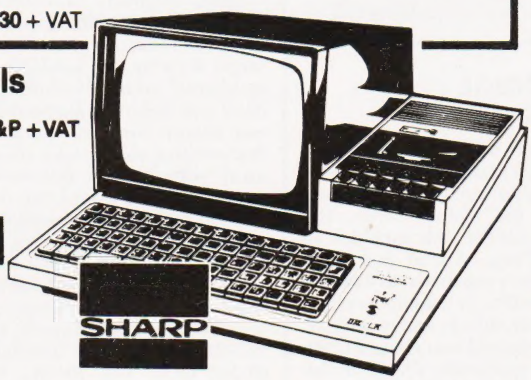

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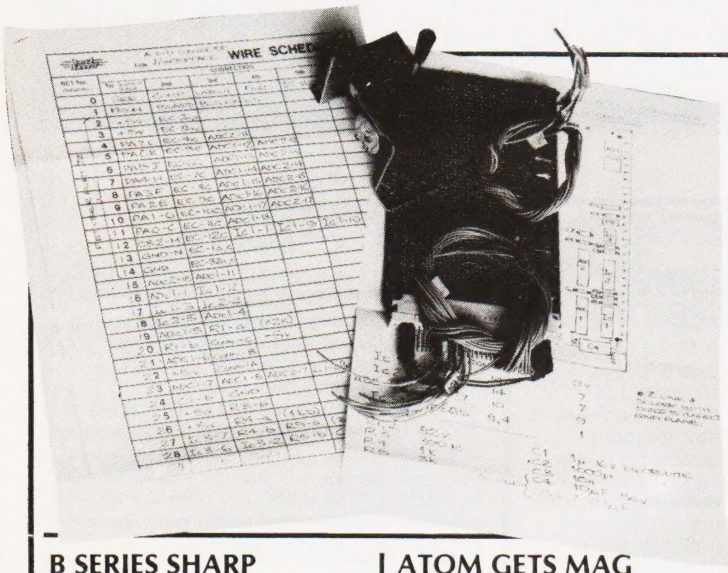


MAKING THE CONNECTION

Many and varied are the ways of connecting components together on a circuit board. CT's projects seem to be built on everything from Veroboard to PCBs using a wide variety of wiring methods, but one enterprising company has chosen to make a feature of its work. A couple of months ago we published the circuit diagrams for a dual channel analogue to digital converter. Construction was on the usual Veroboard with conventional wire links. As a demonstration of their company's product, the Roadrunner wiring pen, T J Brine Associates rapidly assembled the project using their Eurocard-sized board and the wiring pen and sent it back to see what we thought. The result, as you can see from the photograph, is very neat and compact. All the interconnections are worked out before interwiring starts and it is then simply a matter of stringing the wire from point to point, soldering and cutting off as required. To ensure neatness on the underside the wire is fed through 'combs' made of plastic which are stuck between the rows of ICs. A complete kit with a sample board, wiring pen, combs and wire will normally set you back about £18. For further information contact T J Brine Associates at Unit 116, Blackdown Rural Industries, Haste Hill, Haslemere, Surrey GU27 3AY.

B SERIES SHARP

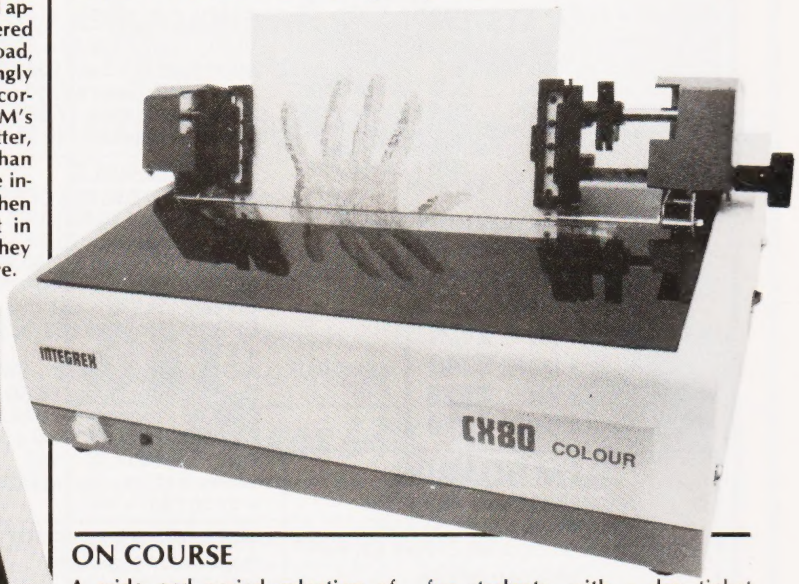
The long awaited variant of the popular MZ80K from Sharp is set to make its debut at the Compec North show at the end of June and will be available from August. Designated the MZ80B it has a typewriter style keyboard rather than the type fitted to the 80K, a green screen capable of displaying 80 columns or 40 and graphics resolution to 320 by 200 dots. The system is Z80A-based with 64K of dynamic RAM, and languages will be loaded in as required. Discs and printer will also be available — the former store 560K per pair — and languages are BASIC and Pascal with a Compiling BASIC due in October. For more information see your local Sharp dealer.

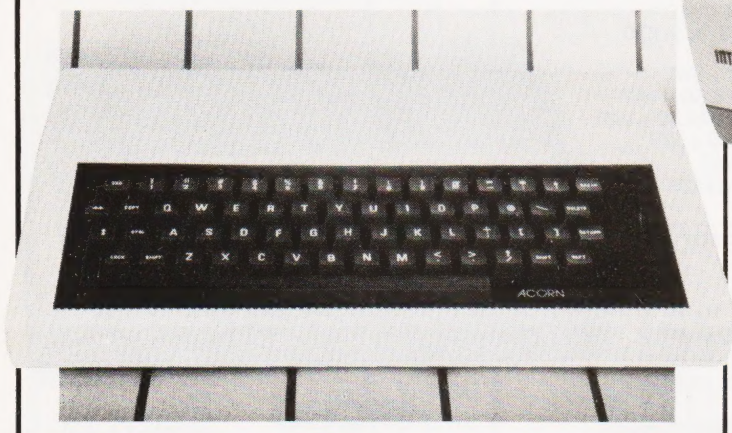
ATOM GETS MAG

The Acorn ATOM has become so popular that one of the major software suppliers is starting up a magazine especially for users of that system. Called 'The ATOM' it will cost 70p per issue including postage or £3.95 for a year's subscription, at least six issues. The first issue will appear in late July and can be ordered from Bug Byte at 251 Henley Road, Coventry CV2 1BX. Interestingly enough we received more correspondence over the ATOM's review and Mr Rolinson's letter, printed in our June issue, than anything else this year. It will be interesting to see what happens when Acorn get the new BASIC out in ATOM form, something that they have promised for the near future.

COLOUR FOR THE PET

No, I'm sorry, this isn't an announcement that the 32K colour PET that I saw at the Hanover Messe a couple of months ago will come to the UK. The colour in this case comes from the Integrex CX80 printer which we featured a couple of months ago which now has an IEEE interface and a set of PET graphics built in. The price of this special version is £895 plus VAT and it can be obtained from Davidson-Richards of 14 Duffield Road, Derby DE1 3BB although there probably are other local suppliers.





ON COURSE

A wide and varied selection of courses have been arranged for the next couple of months, judging by the information that has come in. First on the list is the Ties Computer Course, originally launched using the ZX80 as its training system and now upgraded to the ZX81 with larger systems also available. A full residential course, including seven days' full board at Nutford House, near Marble Arch, will cost £299 and that entitles you to take your ZX81 away with you. A non-residential course will cost from £144. Advanced courses are also available, including training on Pascal, for around £250. A new course starts virtually every week, and details are available from Ties Computer College, 18 Connaught Square, London W2 2HJ or you can telephone on 01-262 6956. The Society for the Study of Artificial Intelligence and Simulation of Behaviour, AISB, are holding an Autumn School at the Open University in Milton Keynes between September 21st and 25th. Residential fees are £195 for industrial, £105 for academic and £75 for students, with a day ticket available at £25. For further information contact Mrs Olwyn Wilson, IET, Open University, Walton Hall, Milton Keynes, MK7 6AA. Cambridge Micro Computers Ltd are offering even more courses and these now include a Z8000 workshop on August 4th to 7th, September 15th to 18th and November 3rd to 6th. The cost of the four days is £232. Other offerings include BASIC, Z80 Assembly language and Pascal. For a full timetable and the prices contact Cambridge Micro Computers at Cambridge Science Park, Milton Road, Cambridge CB4 4BN or ring on 0223-314666. And, finally, the Manchester Polytechnic is running a new course from September which is intended to support the BBC Computer Literacy course. It will cost £240 and includes the price of the upgraded Acorn ATOM which you will build as part of the series of tutorials. Full details can be obtained from John Appleyard, Department of Mathematics, Manchester Polytechnic, Chester Street, Manchester M1 5GD.

TEXAS GO EIGHT

Having spent several years producing 4-bit and 16-bit CPUs, Texas Instruments have finally gone into the 8-bit market. Both the TMS 7020 and the TMS 7000 devices, the first in the range, are single-chip microcomputers complete with I/O circuitry and these are currently being sampled in the field. The TMS 1000 family has not been neglected, however, as a new device called the TMS 2100 series has been introduced. Identical in architecture and instruction set these offer a number of features suitable for industrial control such as an A to D, an interval timer and a bi-directional I/O port. For information on TI's micros, contact their Customer Response Centre at Manton Lane, Bedford MK14 7PA.

CAMBRIDGE EXPANSION

Cambridge Micro Computers, already well known for the courses they run, are offering expansion products for the Video Genie. The EG3013 Expander unit includes an S100 interface, parallel and serial ports, memory expansion to 48K and a disc controller. A complete system with monitor, printer and twin TEAC 5¼" drives would cost about £1,700. The printer stocked by CMC is the bi-directional Epson MX80. Options are available including high resolution graphics depending on the model selected. For pricing details contact Cambridge Micro Computers at Cambridge Science Park, Milton Road, Cambridge CB4 4BN.

CONSUMER NEWS

RALLYING TO THE CAUSE

The 1981 Radio and Electronics Rally will be held at the Park School Further Education Centre, Marlowe Avenue, Swindon, Wilts on 23rd August. Starting at 10 am it will include displays of amateur radio and electronics, including the British Amateur Radio Teleprinter group and AMSAT-UK. As well as being of interest to current and potential users of amateur radio the rally should provide a valuable insight for computer enthusiasts wishing to expand their operations.

MORE TALKING

The General Instrument Microelectronics speech synthesis system that we have mentioned in these columns before is now generally available as a complete unit. Designated the VSM 2032 it consists of three devices; a PIC 1650A micro, the SP 0250 synthesiser and a 32K ROM. Various components are also fitted to provide a 200 mW audio output. The unit has a 32 word vocabulary and costs £49.50. It is available from a number of outlets such as Cambell Collins of 162 High Street, Stevenage, Herts who will also supply such necessary items as the edge connector and speaker.

ALL SCRAMBLED UP

A press release concerning program security, a topic of considerable interest currently, caused mild hilarity in the office. The release concerned a device called the SCRAMBLER, known as a 'dongle' by the hardware buffs, which prevents your programs being listed or copied by the end user. Unfortunately, the device worked so well that no mention of the system for which it was designed was included! By some skilful detective work, reading it again, it seems probable that it is designed for the PET. To solve this puzzle for yourself contact Rick Holland at Microland, 56 Aberdeen Walk, Scarborough, N Yorks YO11 1XW.

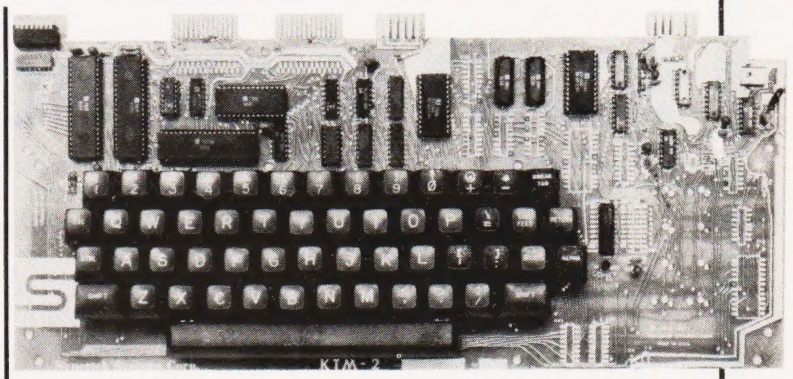
BUG BYTES

It's sackcloth and ashes time again! By now the eagle-eyed among you may have noticed that the Holocaust program appears to have partly vapourised itself, ending rather abruptly at line 1990. The missing chunk is given here, and our apologies are humbly offered to those who may have suffered irreversible brain damage by sticking a RETURN at line 2000! The program itself, once complete, appears to be bug-free thus proving that the new system works even if human error intervenes.

It would also appear that, through no fault of ours, the machine code listing for ZALAMBDODONT has been produced 'back-to-front' by the Assembler. The mnemonics are quite correct, as is the code, but you must make this transition if you are keying in the Hex codes because the Z80 expects to get its low bytes first.

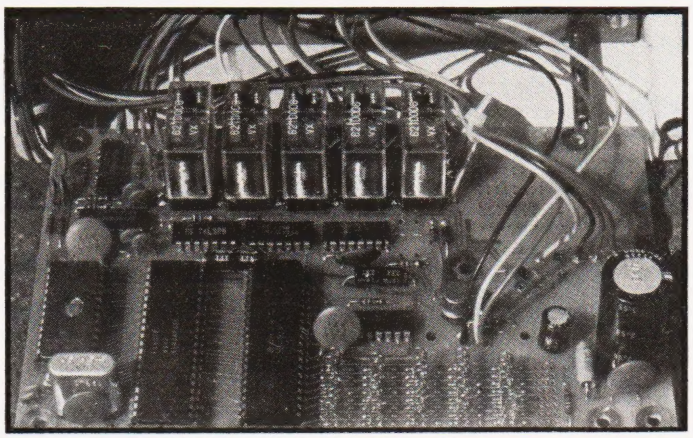
MORE SHARP SOFTWARE

The Newbury based Newbear Computing Store have announced some more software packages for the Sharp MZ-80K personal computer. The first is a machine code program called Apollo which is a word processing package. The editor section allows text to be created, modified and stored on cassette and features global search and replacement. The keyboard is automatically changed to operate in conventional typewriter mode and a range of printers are supported including the Epson. The processor section allows right justification and printer control. Newbear have also introduced a disc-based assembler configured around their popular ZEN package. The price of the assembler is £37.50 plus VAT. Two other programs recently introduced include a Music Composer for £10 and a Program Filing Index for £5. Full details are available from Newbear at 40 Bartholomew Street, Newbury, Bucks.



RETURN OF SYM

Micro owners looking for a cheap VDU may be interested to hear of the re-emergence of the KTM-2 terminal unit. Produced by Synertek, the people who brought you the SYM-1, it is available as a 24 by 40 or 24 by 80 format terminal capable of driving a TV or a monitor. A full 54-key ASCII keyboard is fitted and interfacing is via an RS232 port with baud rates between 110 and 9600. An auxiliary port is also fitted. A number of cursor controls and simple editing functions are included. Prices are £226 for the 40 column version and £257 for the 80 column. Full details can be obtained from Pronto Electronic Systems at 466-478 Cranbrook Road, Gants Hill, Ilford, Essex IG2 6LE.



TIM TAKES CONTROL

Smallest in the newly announced range of industrial controllers from EME, TIM is based on a 6802 CPU and offers a number of dedicated inputs and outputs together with eight user programmable lines. Up to six eight-way DIL switches can be fitted to set parameters that may need to be altered without recourse to the original program. Applications include process control, alarm systems and coin-operated equipment and the unit is available in a number of variants; cased, open frame, bare board etc. For a full technical specification of TIM and his bigger brothers contact EME at 5 Port Hill, Hertford, Herts SG14 1TJ.

```
2000 FOR Y=0 TO 47
2010 SET(30,Y)
2020 SET(127,Y)
2030 NEXT Y
2040 PRINT @1,"DEVASTATION!";
2050 PRINT @128,"H BOMBS";HB;
2060 PRINT @192,"A BOMBS";AB;
2070 PRINT @256,"N BOMBS";NB;
2080 PRINT @384,"SCORE :";SC;
2090 FOR V=1 TO 14
2100 POKE VA+V*64+17+RND(40),42
2110 NEXT V
2120 PRINT @512,"CITIES ";CT;
2130 FOR V=0 TO 5
2140 AX(V)=62
2150 AY(V)=V
2160 AY(V+6)=11-V
2170 AX(V+6)=62
2180 NEXT V
2190 GOSUB 130
2200 GOSUB 130
2210 GOTO 1530
2220 REM**ATTACKERS WIN
2230 SC=SC+1000
2240 GOSUB 2310
2250 PRINT @640,"COUNTRY OVERRUN";
2255 GOTO 2450
2260 SC=SC+1000
2270 GOSUB 2310
2280 PRINT @640,"OUT OF MISSILES";
2290 GOTO 2450
2300 REM**END OF GAME
2310 FOR T=0 TO 5
2320 FOR T1=0 TO 200:NEXT T1
2330 PRINT @768,"<BATTLE OVER>";
2340 PRINT @391,"[7 SPC]";
2350 FOR T1=0 TO 200:NEXT T1
2360 K$=INKEY$
2370 PRINT @768,"[13 SPC]";
2380 PRINT @391,SC;
2390 FOR T1=0 TO 200:NEXT T1
2400 NEXT T
2410 RETURN
2420 REM**DEFENDERS WIN
2430 GOSUB 2310
2440 PRINT @640,"ENEMY SURRENDER";
2450 K$=INKEY$:IF K$="" THEN 2450
2460 REM**THAT'S ALL FOLKS!
2470 END
```

Apple, Pet, TRS-80

STAR WARRIOR

For the Stellar Union, it was just another war of conquest. For the peaceful people of Fornax, it was prelude to a year of subjugation, humiliation, and frustration. Finally, they had had enough: they called in the Furies.

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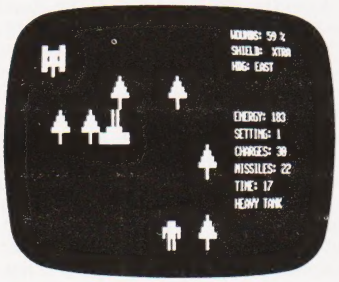

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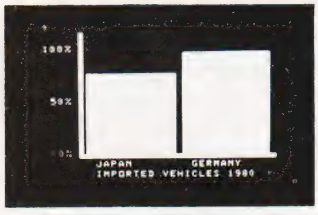

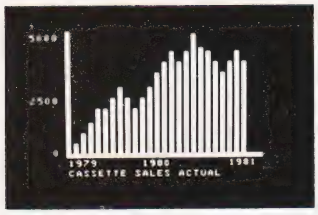

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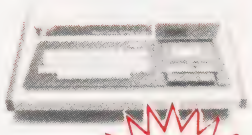

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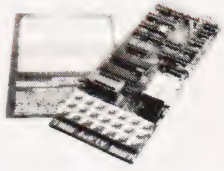

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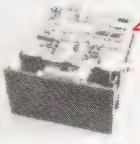

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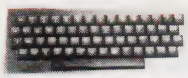

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OEM M TWO

The M Two microsystem that keeps finding its way onto these pages has managed it yet again. LSI Computers are now offering it in OEM format for those wishing to create their own systems with the minimum of fuss. Based on an 8085 CPU with 64K of RAM and 4K of EPROM, the card cage has room for 12 boards. Apart from the CPU and RAM boards the other 'standards' are a peripheral board supporting two VDUs and a printer, a floppy disc controller for twin double density 8" drives and a controller for an 8" hard disc. Operating systems are CP/M and the range of languages available is good. As well as supplying the 'bare bones' LSI will also provide cases, desk units and custom requirements as necessary. The basic system will cost around £6,000. More details are available from LSI Computers Ltd at Copse Road, St Johns, Woking, Surrey GU21 1SX or ring on 04862-23411.

TI'S INTELLIGENT BUBBLES

Texas have announced two new bubble memory terminals which can perform their own data validation before transmitting the stored information to the host computer. The new models are the Silent 767 and 769 and, in common with the rest of the family, use a 5 by 7 thermal matrix head to live up to their name. A full ASCII keyboard is standard on both models. The 769 incorporates an acoustic coupler running at 300 baud as well as the 3780 batch transmission mode for sending information to the host. Prices are £2,760 for the 767 and £2,960 for the 769 and they will be available in the third and fourth quarter respectively. Further technical information can be obtained from TI at Manton Lane, Bedford MK41 7PA.

ON THE ROUNDS

One of the areas in which microcomputers actually seem to be making a significant impact is the retail news trade. Yet another package has been launched, called Newsround, and this one comes from the Computer Room. Based on — and sold with — a Superbrain for £3,790, complete with printer and the other necessities, the package is also available separately for £600 or you can lease the system. Its facilities include the production of customer statements, round lists, automatic substitution and holiday cancellations, adding-in of miscellaneous purchases and planning of forward orders. Although the press release doesn't make it clear it would appear that the program runs under CP/M so it should be possible to implement it on systems other than the Superbrain if you already have a computer. Further information can be obtained from the Computer Room on 0732-355962 or by writing to them at 87 High Street, Tonbridge, Kent TN9 1RX.

DE MINI CAT

Arriving just too late for inclusion in our media survey was a new A5-sized catalogue from Data Efficiency to supplement their bigger annual publication. Nothing drastically new is contained in the information, but many of the prices have actually dropped. One of the more interesting items that we only mentioned briefly in the survey is a custom desk for micro systems. The basic unit costs £48, with an extra shelf for monitors etc costing £31. For your copy contact Data Efficiency at Maxted Road, Maylands Avenue, Hemel Hempstead, Herts HP2 7LE.

LOW-COST DAISY

Penny and Giles are now importing the Robotron daisy wheel printer at a one-off price of £863. The device prints at 40 cps and has programmable font change, pitch and format functions and can even be ordered as a split platten type allowing two sets of tractors to give an effective width of 253 characters. Ribbons and daisies are easily exchanged and the interfaces are Centronics or standard parallel types. For more information contact Penny and Giles at Mudeford, Christchurch, Dorset BH23 4AT.

HP MICRO RUNS MINI SOFTWARE

A new, lower priced entry-point into the HP1000 family has been introduced by Hewlett Packard. Called the Model 5 it costs under £6,000, a 40% reduction over the previous starter system. The package includes the L series microcomputer, twin 270K mini floppies and the VDU in a desktop configuration, expansion in I/O and discs is readily available. Two real-time operating systems are available, RTE-L which is execute-only for up to 64K of system RAM and RTE-XL, which is capable of handling systems up to 512K. Both are multi-user, multi-tasking in operation. Languages include HP's Pascal, FORTRAN, BASIC and a compiler. For further information on the basic system and the many options contact the Technical Computer Systems Group, Hewlett Packard, King Street Lane, Winnersh, Wokingham, Berks RG11 5AR.

BUSINESS NEWS

SEEDING THE MARKETPLACE

A new 6809-based system called the SEED System 19 is offered by Strumech from the beginning of June. It certainly seems to bear out the trend we outlined in a recent article on the revival of the SS50 bus as it uses this format. Associated with the 6809 is a serial port, 48K of RAM and a floppy disc in 5¼" or 8" available in any of the four options of size. A choice of operating systems is also offered; OS-9 with BASIC09, a Macro text editor, an Interactive Assembler and the Stylograph wordprocessor or the DOS69 with a BASIC Interpreter, the SE-92 Editor and its companion Assembler, the TP-92 Text Processor and the MACRO69 Macroassembler. The system has been on field trials for the last month with existing SEED users. Typical prices are between £2,075 and £2,835 for the hardware and the operating systems about £500 extra. A terminal and a printer would add another £1,500 to the price. For full technical details and information on the rest of the range of equipment distributed contact Strumech at Portland House, Coppice Side, Brownhills, West Midlands.

MINI WINNIE FROM BASF

A new OEM 5¼" Winchester technology disc drive is being launched by BASF. The 6180, as it is known, will be available in 6.38Mb and 9.57Mb versions, two or three platters respectively. Up to four can be strung together or they can be used in conjunction with BASF's 6106 or 6108 mini floppy units to provide a total of 38Mb. The drives will be available in the second half of this year and information and prices can be obtained from BASF at 4 Fitzroy Square, London W1P 6ER.

TOUCH TERMINAL

Newly introduced by VSI Electronics is an interactive data terminal from RCA. Called the VP-3301, it uses a flat membrane type keyboard and generates a display on either a monitor or via a modulator on a TV set. The display format can be 24 by 40 or 12 by 20 and there is a choice of eight display colours or grey scales if required. User-defined characters may be added to the 125 already built-in and reverse video is also available. The external connection is via an RS232 or 20 mA serial interface and a variety of switch selectable baud rates and interface configurations. For pricing and more technical information contact VSI at Roydenbury Industrial Park, Horsecroft Road, Harlow, Essex CM19 5BY.

NEW NEWBURYS

Newbury Labs, already well known in the VDU market, have announced a new range of devices under the 8000 series banner. The 8003 is effectively a re-cased version of the 7003 (they now use styled plastic instead of metal), and the 8009 comes in as the flagship of the range. Both feature V24 or current loop interfaces, 12" green screens, tiltable displays and detached keyboards. Prices start at £559 one-off end user. The 8009 VDU incorporates 10 software function keys which can be preprogrammed by the operator in addition to the common screen format programming which can be done on either. The format information is held in battery-powered CMOS RAM and will stay there for several months, even with the power off. Despite the new case styling facility Newbury will continue to produce metal cased VDUs. For a technical specification contact Andy Surtees at Newbury Laboratories, Arnhem Road, Newbury, Bucks or ring him on 0635-48864.

PHL EXPAND RANGE

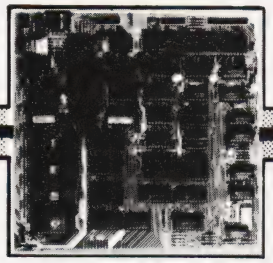
As well as marketing the Anadex, Teletype and DEC Writer ranges of printers, Peripheral Hardware are now stocking Okidata's Microline range. First to come in, by the end of June, will be the 82 and 83 models which print at between 120 and 180 cps. Also likely to make an appearance soon is the Florida Data Corporation's 600 cps matrix printer which can be slowed down to about 150 cps giving a correspondence quality output. This system costs £2,100 but it does offer two-in-one flexibility. For more information on any of the ranges they stock contact Peripheral Hardware at Armfield Close, West Molesey, Surrey.

POLKA-DOT COMEBACK

Adler Business Systems are no more: their name is now Triumph Adler (UK) Ltd. With this change of identity they have launched, through OEM (an associated company), a pair of educational systems. The TA Tutor is a 'computerised electronic typewriter' which can perform invoicing functions and sales and purchase ledgers. We covered its launch in the commercial field some months ago as the TA Invoicer. The second product is the Bitsy Tutor, a complete wordprocessing package designed for the educational market. It comes complete with a training programme and one of the new Triumph daisywheel printers. For information on both of these products contact The Marketing Department, Office and Electronic Machines, 140 Borough High Street, London SE1 or ring them on 01-407 3191.

MicroValue

New British Microsystem. Gemini MultiBoard

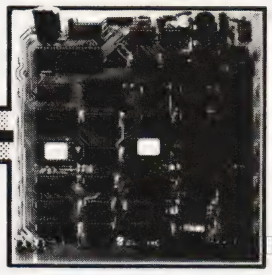


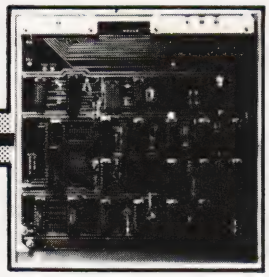
● Eight boards available NOW ● 8" x 8" board modules ● Z80A CPU board ● Z80A Video board ● 64K RAM ● Built and tested

Developed by one of the most experienced micro board design teams in the UK, Gemini MultiBoard* is the ultimate modular board system. Unlike most systems of its kind, virtually nothing is made redundant when you expand it. And for those who want expansion this can be immediate, for we are launching eight boards simultaneously. No other system has offered so much so soon.

All MultiBoard modules are Nasbus† and Gemini 80-BUS* compatible and can be used in a wide spectrum of application, e.g. educational, personal, business, system development and process/production control.

MultiBoard modules are built and tested to the highest standards. And offer enormous computing power and potential at astonishingly low cost.





MultiBoard Modules available now

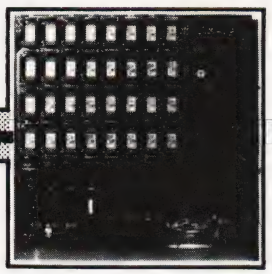
Z80A CPU

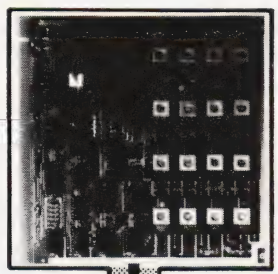
Processor: Z80A CPU at 4MHz. Optional wait-states. Reset jump to any 4K boundary.

Parallel I/O: 8 bit ASCII keyboard socket. Uncommitted Z80A PIO giving two 8 bit bi-directional ports with handshake.

Serial I/O: 8250 UART with programmable baud rates and software selectable between RS232 or 1200 baud CUTS cassette interfaces.

Memory: 4 'Bytewyde' sockets to accept EPROM/ROM/RAM. Memory switched in/out of memory map under software control.





Software: Comprehensive monitor. Optional 12K Microsoft BASIC (ROM). Standard configuration PROM provides decodes for 4 x 2732 (4K x 8) EPROMs.

The CPU Board is fully buffered to the Gemini 80-BUS standard.

INTELLIGENT VIDEO

- Z80A microprocessor controlled.
- 80 x 25 display controlled by 6845 CRTC chip.
- Adjustable dot clock for alternative screen formats.
- Character set: 128 in EPROM + 128 in RAM which can be defined as the video inverse of the main set or as block graphics with 160 x 75 resolution.
- I/O port communication with host computer.
- Light pen socket.
- 8-bit input port allowing several video boards (each with its own keyboard) to be connected to a single CPU board.

FLOPPY DISK CONTROLLER

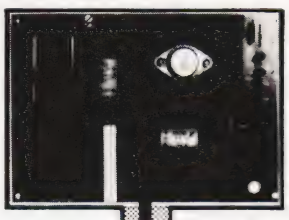
- Controls: Pertec FD250 5.25in 48 TPI, Micropolis 1015 5.25in 96 TPI, Pertec FD514 8in.
- Controls up to 4 drives of same type.
- Single/double density software selectable.
- Single or double sided.
- Western Digital FD1797 controller.
- Up to 8 drives (2 boards) can be used in the same system.

64K RAM

- Runs at 4MHz with no wait-states.
- 4 banks of 16K dynamic RAM, each bank locatable on any 4K address boundary.
- Page Mode supplied as standard allowing up to 4 memory boards to be addressed.
- All the memory can be used by switching out on-board CPU memory, e.g. in disk environment.

EPROM/ROM BOARD

- Accepts up to 40K of firmware.
- 4 banks of 4 sockets.
- Banks can be mixed between 2708 or 2716.
- 24-pin ROM socket.
- Wait-state generator.
- Supports Page Mode scheme.



EPROM PROGRAMMER

- Programs multi-rail 2708 or single rail 2716.
- Connects to PIO on CPU board.
- Software provided on tape.

3A PSU

- Supplies 4/5 boards.
- LED on each output.
- +5V at 3A; +12 at 1A; −5V at 1A; −12V at 80mA.

KEYBOARD

- Full alpha-numeric ● 59-keys ASCII encoded ● Exclusively designed for Gemini ● Auto repeat ● Cursor control keys

MULTIBOARD PRICES (excl VAT)

(All built and tested except where marked)

CPU (G811)	£125.00
Video (G812)	£140.00
64K RAM (G802)	£140.00
FDC (G809)	£140.00
EPROM/ROM (G803)	£ 70.00
EPROM PROG. (G808) Kit	£ 29.50
3A PSU (G807)	£ 40.00
Keyboard (G613)	£ 57.50

FLOPPY DISK UNIT

Gemini unit suitable for MultiBoard. Holds one or two 5¼in double sided, double density Pertec drives. Intergral power supply. Price £375 plus VAT for one drive, £575 plus VAT for two drives. CP/M2.2 and documentation £90 plus VAT.

KENILWORTH CASE for MultiBoard	£49.50 + VAT
5-Card Support Kit	£19.50 + VAT
VERO Frame	£32.50 + VAT
(also suitable for Nascom)	
PSU Enclosure Kit	£24.50 + VAT

KEYBOARD enclosures available soon.

MultiBoard Modules are available from the MicroValue dealers listed on facing page.

*Trademarks of Gemini Microcomputers Limited
†Trademarks of Nascom Microcomputers Division of Lucas Logic
††Trademarks of Digital Research Inc.

MicroValue

COMPATIBLE Nasbus products from your MicroValue Dealers

GEMINI G805 FLOPPY DISK SYSTEM FOR NASCOM-1 & 2

It's here at last. A floppy disk system and CP/M

CP/M SYSTEM. The disk unit comes fully assembled complete with one or two 5¼" drives (FD250 double sided, single density) giving 160K per drive, controller card, power supply, interconnects from Nascom-1 or 2 to the FDC card and a second interconnect from the FDC card to two drives, CP/M 1.4 on diskette plus manual, a BIOS EPROM and a new N2MD PROM. All in a stylish enclosure.

Single drive system ..... **£450 + VAT**
Double drive system ..... **£640 + VAT**
Additional FD250 drives ..... **£205 + VAT**

D-DOS SYSTEM. The disk unit is also available without CP/M to enable existing Nas-Sys software to be used. Simple read, write routines are supplied in EPROM. The unit plugs straight into the Nascom PIO. Single drive system **£395 + VAT**

DCS-DOS A greatly enhanced version of D-DOS, running under Nas-Sys. Gives named files in BASIC, ZEAP, NAS-PEN and machine code programs ..... **£50 + VAT**

DISKPEN

The powerful text editor written for the Nascom is now available on a 5¼ inch floppy disk with a number of new features. **Price £43.25 + VAT.**

NASCOM COMPUTERS

NASCOM-2 Microcomputer Kit
£225 + VAT
NASCOM-1 Microcomputer Kit
£125 + VAT
Built and tested **£140 + VAT**

16K RAM KIT ..... £100 + VAT
3A PSU KIT ..... £32.50 + VAT

KENILWORTH CASE FOR NASCOM-2

The Kenilworth case is a professional case designed specifically for the Nascom-2 and up to four additional 8" x 8" cards. It has hardwood side panels and a plastic coated steel base and cover. A fully cut back panel will accept a fan, UHF and video connectors and up to 8 D-type connectors. The basic case accepts the N2 board, PSU and keyboard. Optional support kits are available for 2 and 5 card expansion.

Kenilworth case ..... **£49.50 + VAT**
2-card support kit ..... **£7.50 + VAT**
5-card support kit ..... **£19.50 + VAT**

CASSETTE ENHANCING UNIT

The Castle interface is a built and tested add-on unit which lifts the Nascom-2 into the class of the fully professional computer. It mutes spurious output from cassette recorder switching, adds motor control facilities, automatically switches output between cassette and printer, simplifies 2400 baud cassette operating and provides true RS232 handshake.

Castle Interface Unit ..... **£17.50 + VAT**

A NASCOM-2 BASED SYSTEM FOR LESS THAN £1500 + VAT

The proven Nascom-2 microcomputer can now be bought as a complete system from under £1500 + VAT. For this price you get the Nascom-2 kit, 16K RAM board kit, Kenilworth case with 2 card frame, Centronics 737 printer—10 inch monitor, and the Gemini Dual Drive Floppy Disk System. The CPU and RAM boards are also available built – the additional cost is available on application.

A-D CONVERTER

For really interesting and useful interactions with the 'outside world' the Milham analogue to digital converter is a must. This 8-bit converter is multiplexed between four channels – all software selectable. Sampling rate is 4KHz. Sensitivity is adjustable. Typical applications include temperature measurement, voice analysis, joystick tracking and voltage measurement. It is supplied built and tested with extensive software and easy connection to the Nascom PIO.

Milham A-D Converter
(built and tested) ..... **£49.50 + VAT**

PROGRAMMER'S AID

For Nascom ROM BASIC running under Nas-Sys. Supplied in 2 x 2708 EPROMs. Features include: auto line numbering; intelligent renumbering, program appending; line deletion; hexadecimal conversion; recompression of reserved words; auto repeat; and printer handshake routines. When ordering please state whether this is to used with Nas-Sys 1 or 3. **Price £28 + VAT.**

GEMINI 'SUPERMUM'

12 x 8 piggy-back board for Nascom-1 offering five-slot motherboard, quality 5A power supply and reliable buffering with reset jump facility. **Kit Price £85 + VAT.**

CENTRONICS 737 MICRO PRINTER

A high performance, low price, dot-matrix printer that runs at 80cps (proportional) and 50cps (monospaced). This new printer gives text processing quality print. And can print subscripts and superscripts. It has 3-way paper handling and parallel interface as standard. Serial interface is optional. **Price £375 + VAT.** Fanfold paper (2000 sheets) **£18 + VAT.**

BITS & PC's PCG

5 x 4 board which plugs straight into Nascom-2. Operates on cell structure of 128 dots, producing 64 different cells. Once defined, each cell may be placed anywhere, any number of times on screen simultaneously. Max screen capacity: 768 cells. Dot resolution: 384 x 256 98304. Many other features including intermixing of alpha-numeric characters and pixels. **Price (kit) £60 + VAT.**

PORT PROBE

Allows monitoring of input and output of Nascom PIO. This board can generate interrupts and simulate handshake control. **Price (kit) £17.50 + VAT.**

All prices are correct at time of going to press and are effective 1st July 1981.

HEX & CONTROL KEYPADS

Hexadecimal scratchpad keyboard kit for N1/2. **Price £34 + VAT.**

As above but including (on the same board) a control keypad kit to add N2 control keys to N1. **Price £40.50 + VAT.**

BASIC PROGRAMMER'S AID

Supplied on tape for N1/2 running Nas-Sys and Nascom ROM BASIC. Features include auto line number, full cross-reference listing, delete lines, find, compacting command, plus a comprehensive line re-numbering facility. **Price £13 + VAT.**

'SCREENPLUS'

Screenplus enables a programmer to blank or display in reverse video, selected words, letters or areas of the screen under program control. Suitable for use with either Nascom 1 or 2. 'Screenplus' (built and tested) .... **£40.00 + VAT.**

DUAL MONITOR BOARD

A piggy-back board that allows N1 users to switch rapidly between two separate operating systems. **Price (kit) £6.50 + VAT.**

YOUR LOCAL MICROVALUE DEALER

All the products on these two pages are available while stocks last from the MicroValue dealers listed below.
(Mail order enquiries should telephone for delivery dates and post and packing costs.) Access and Barclaycard welcome.

BITS & PC'S
4 Westgate, Wetherby, W. Yorks.
Tel: (0937) 63774.

BUSINESS & LEISURE MICROCOMPUTERS
16 The Square, Kenilworth, Warks.
Tel: (0926) 512127.

ELECTROVALUE LTD.
680 Burnage Lane, Burnage, Manchester M19 1NA.
Tel: (061) 432 4945.

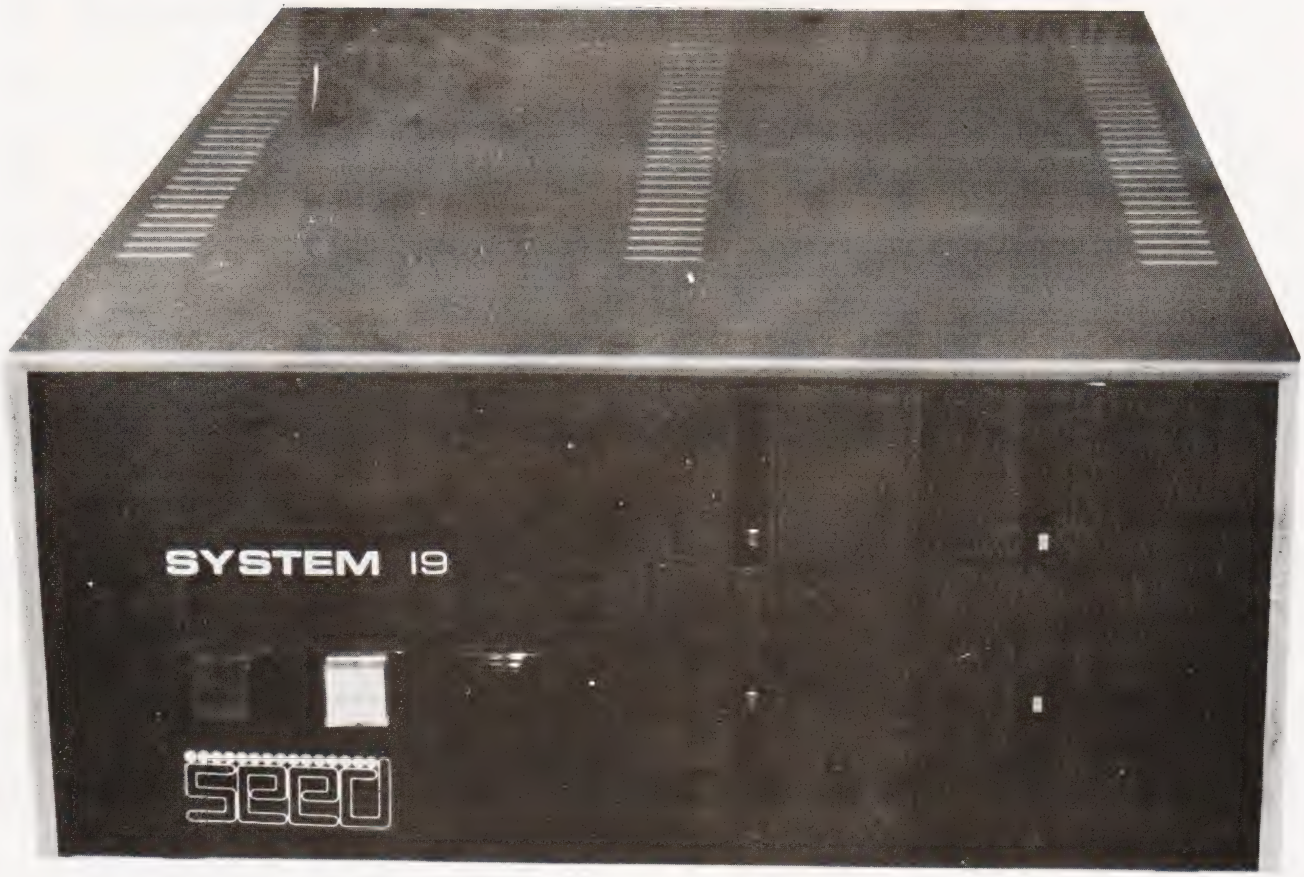
28 St Judes, Englefield Green, Egham, Surrey TW20 0HB.
Tel: (0784) 33603. Tlx: 264475.

TARGET ELECTRONICS
16 Cherry Lane, Bristol BS1 3NG.
Tel: (0272) 421196.

INTERFACE COMPONENTS LTD.
Oakfield Corner, Sycamore Road, Amersham, Bucks.
Tel: (02403) 22307. Tlx: 837788.

HENRY'S RADIO
404 Edgware Road, London W2.
Tel: (01) 402 6822.
Tlx: 262284 (quote ref: 1400).

THE SEED SYSTEM *19*



+ OS-9

THE ULTIMATE COMBINATION OF HARDWARE AND SOFTWARE

6809 BASED PROCESSSOR WITH 56K RAM

RUNNING MICROWARE OS-9 WITH 2.4 MEGABYTE FLOPPY DISK SYSTEM

TRUE MULTI-USER/MULTI-TASKING CAPABILITY

FOREGROUND/BACKGROUND TASKS

FAST BASIC INTERPRETER/COMPILER

EDITOR/ASSEMBLER

PRICES FROM £2375.00

seed

STRUMECH

PORTLAND HOUSE, COPPICE SIDE,

BROWNHILLS, WEST MIDLANDS.

TELEPHONE: BROWNHILLS 78151

TELEX 335243

ELEMENTAL ANALYSIS

Donald R Randell

Unscramble chemical formulas with this BASIC program

This elemental analysis program is written in TRS-80 Level II BASIC and occupies some 2.5K of RAM, although it should prove easy to adapt to other systems.

It is designed as an aid to the chemist who has to analyse compounds containing any combination of the following eight elements: Carbon, Hydrogen, Nitrogen, Oxygen, Phosphorous, Sulphur, Chlorine and Bromine.

Using It

One can choose from the short menu to either calculate the percentage contents of the elements from the inputs of the number of atoms of each, or to calculate the empirical and molecular formulas from inputs of the percentage composition. The latter calculation is performed by reducing to unity the atomic content of the heteroatoms or halogens present in the compound.

Each part of the program uses the subroutine between 910 and 970 to read into arrays, A$(X), B$(X) and W(X), the element name, symbol and atomic weight respectively. These are then used in various loops to input the data, the calculations and the tabular output. By simply altering the DATA lines the program can be tailored for other classes of compound; SILICON, SI,28.06 could replace BROMINE,BR,79.916 for example.

In order to get a neat display of the results the spacing indicated should be adhered to. Those who have a printer can use the LPRINT statement wherever appropriate to produce hard copy results.

Program Listing

```
 20  CLS
 30  PRINT" [13 SPC ] ************************************"
 40  PRINT" [13 SPC ]*   ELEMENTAL ANALYSIS PROGRAM   *"
 50  PRINT" [13 SPC ] ************************************"
 60  PRINT
 70  REM**SELECT E.A. OR M.F. CALCULATION
 80  PRINT"FOR CALCULATION OF PERCENT ELEMENTAL
     ANALYSIS"
 90  PRINT"AND MOLECULAR WEIGHT OF A COMPOUND TYPE
     '1' "
100  PRINT
110  PRINT"FOR CALCULATION OF MOLECULAR FORMULA
     FROM"
120  PRINT"PERCENT ELEMENTAL ANALYSIS TYPE '2' "
130  PRINT
140  INPUT X:ON X GOTO 160,570
150  REM**E.A. +M.W. CALCULATION
160  CLS
170  PRINT" [7 SPC ] ******************************"
180  PRINT" [7 SPC ]*  ELEMENTAL COMPOSITION  *"
185  PRINT" [7 SPC ]*  AND MOLECULAR WEIGHT  *"
190  PRINT" [7 SPC ] ******************************"
200  PRINT
210  GOSUB 910
220  REM**INPUT DATA
230  PRINT@268, "ENTER REF.NO. ";
240  INPUT K$
250  FOR X=0 TO 7
260  PRINT@332+(X*64), "ENTER NO. OF ";A$(X);" ATOMS";
270  INPUT E(X)
280  MW=MW+(E(X)*W(X))
290  NEXT X
300  REM**OUTPUT RESULTS
310  CLS
320  PRINT"% ELEMENTAL COMPOSITION AND MOLECULAR
     WEIGHT OF ";K$
330  PRINT"-------------------------------------------------------------------"
340  PRINT"MOL.FORMULA ";
350  FOR X=0 TO 7
360  IF E(X)=0 GOTO 400
370  IF E(X)=1 GOTO 390
380  PRINT B$(X);E(X);:GOTO 400
390  PRINT B$(X)" [SPC ]";
400  NEXT X
410  PRINT
420  PRINT"MOL.WT.   ";
430  FOR X=0 TO 7
440  IF E(X)=0 GOTO 460
450  PRINT"%";B$(X);" [5 SPC ]";
460  NEXT X
470  PRINT
480  A$="#####.##"
490  PRINT USING A$;MW;
500  FOR X=0 TO 7:P(X)=E(X)*W(X)*100/MW
510  IF E(X)=0 GOTO 530
520  PRINT USING A$;P(X);
530  NEXT
540  PRINT
550  END
560  REM**M.F. CALCULATION
570  CLS
580  PRINT" [9 SPC ]*********************************"
590  PRINT" [9 SPC ]*          MOL. FORMULA          *"
595  PRINT" [9 SPC ]* FROM ELEMENTAL ANALYSIS *"
600  PRINT" [9 SPC ]*********************************"
610  PRINT
620  GOSUB 910
630  REM**INPUT DATA
640  PRINT@268,"ENTER REF. NO. ";
650  INPUT K$
660  FOR X=0 TO 7
670  PRINT@332+(X*64),"ENTER %";A$(X);
680  INPUT F(X)
690  NA(X)=F(X)/W(X)
700  NEXT X
710  REM**OUTPUT RESULTS
720  CLS
730  PRINT" [13 SPC ]MOLECULAR FORMULA OF ";K$
740  PRINT" [13 SPC ]----------------"
750  A$="#####.##"
760  FOR X=0 TO 7
770  IF NA(X)=0 GOTO 790
780  PRINT" [4 SPC ]";B$(X);" [4 SPC ]";
790  NEXT X
800  PRINT
810  FOR Y=2 TO 7
820  FOR X=0 TO 7
830  IF NA(X)=0 THEN GOTO 870
840  IF NA(Y)=0 THEN GOTO 880
850  Z(X)=NA(X)/NA(Y)
860  PRINT USING A$;Z(X);
870  NEXT:PRINT
880  NEXT Y
890  PRINT" [3 SPC ]OR MULTIPLES THEREOF !!!"
900  END
910  FOR X=0 TO 7
920  READ A$(X),B$(X),W(X)
930  NEXT X
940  DATA "CARBON","C",12.01,"HYDROGEN","H",1.008,
     "NITROGEN","N",14.008
950  DATA "OXYGEN","O",16.00,"PHOSPHORUS","P",30.98,
     "SULPHUR","S",32.06
960  DATA "CHLORINE","CL",35.457,"BROMINE","BR",79.916
970  RETURN
```

computing today

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GETTING INTO PRINT

Attaching a printer to the back of one's microcomputer may appear to be a simple enough job but there may well be pitfalls. We take the specific example of a computer and a printer with the 'industry standard' parallel interface and try to connect them together. The result is an object lesson for anyone considering the purchase of a printer for their system.

POOLING ONE'S RESOURCES

It's that time of the year again. The bottom drawers are being rummaged through for the long woolly scarves and the bobble hats, the rattles are being dusted off and the vocal chords exercised with quick snatches of 'You'll never walk alone. . ! Yes, folks, it's football time again. To go with the revival of the supporter comes the annual pilgrimage to ensure the weekly supply of pools coupons and the anxious nibbling of pencil ends as these are religiously filled in.

What you'd all like, of course, is a foolproof method of filling them in correctly. Analysis of past performance can be very valuable in determining the future prospects of any team and the first part of our pools prediction article takes a look at how you can incorporate this into a computer program. It may not guarantee a winning entry but it'll certainly put your micro to good use!

MEMORY PLUS

As the cost of semiconductor memory falls many people must be wondering how they can expand the system they thought was big enough six months ago. One of the more popular computers is the Commodore PET and many people have asked if versions of this can be expanded. In our next issue we show you how to upgrade a 16K system to 32K with the minimum of fuss and bother.

ROBOTIC RAMBLINGS

Did you know that there was a special language developed just for controlling robots? With all the current interest in these devices our Language of the Month series takes a look at WSFN which is designed specifically for robot control.

IS VIC THERE?

The new personal computer from Commodore is attracting a lot of attention at the moment. Equipped with colour graphics, sound and the promise of easy expansion it certainly appears to offer a very nice starting point for the home computerist. Just how it measures up on test and whether the promises it makes are fulfilled are the sort of questions that will be answered in next month's issue.

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

COMPUTING TODAY · NEXT MONTH · COMPUTING TODAY · NEXT MONTH

ON SALE AT YOUR NEWSAGENT FRIDAY 14th AUGUST

COMPUTING TODAY · NEXT

CUBIK

Iolo Davidson

If that cube is slowly driving you mad then this program may help. It doesn't solve the problem but it can make life easier.

This program simulates the cubical puzzle which has become a craze among mathematicians and computer scientists, as well as puzzle freaks, all over the world. Devotees are spread more thinly in Britain but include 'cubemeisters' of international repute.

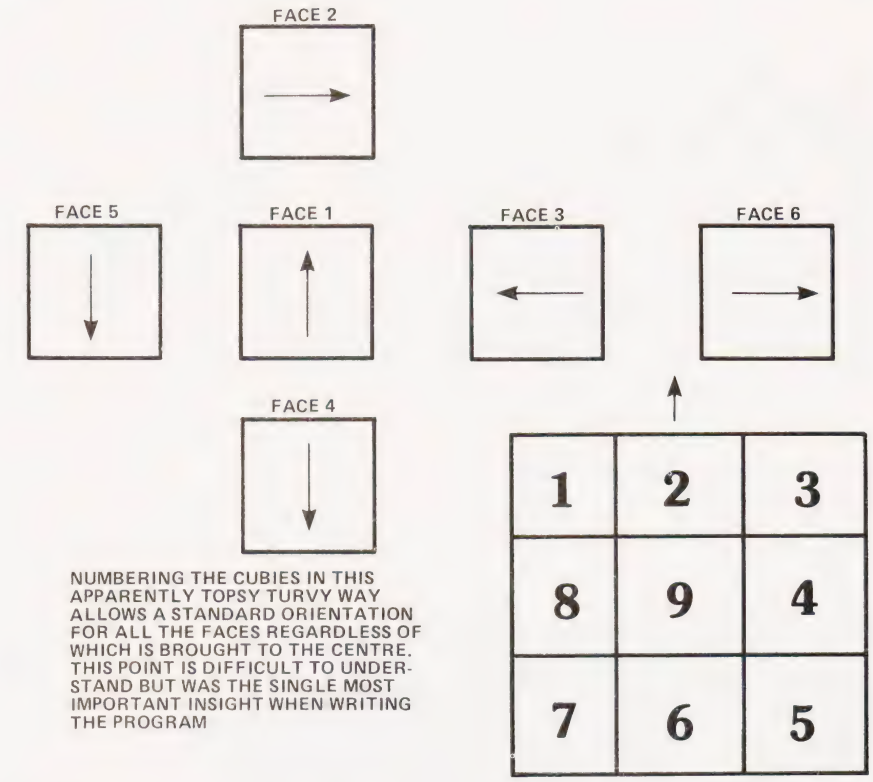
Rubik's Cube

The physical puzzle is a plastic cube apparently made up of 27 smaller cubes, all stuck together in a manner which allows any face of the larger cube to be rotated at will (how this is possible is a puzzle on its own), with the consequence that the smaller cubes can be made to wander around the larger. This would be to little purpose except that the cube comes in its start position with the six sides each having a different colour. Few rotations are necessary to scramble the colours on all the faces, which is the point at which the puzzle begins. Restoring the cube to the start position is so difficult that it is said that each puzzler must evolve a personal science of cube manipulation, with which any scrambled state could be solved. Once this is achieved further refinement is still necessary to do it more quickly. The world record for unscrambling a cube is now well under a minute.

The Simulation

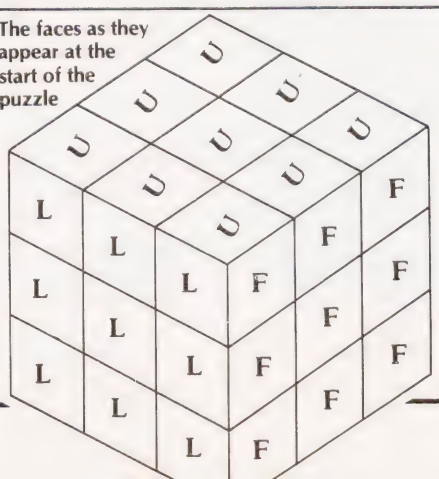
As the Triton lacks colour graphics, I have represented the faces of the 'cubies' with a letter, and rather than have the letter represent a colour, I have chosen the letters used in cubology notation, which makes it easier to follow published cube move sequences. These letters represent the faces Front, Back, Left, Right, Up and Down, but if you prefer colours, you can have Red, Blue, Lilac, Damson, Fuchsia and Umber! Even in a scrambled state the central cubies stay put and only the edge and corner ones move to other faces, so the letter on the central cubie identifies the 'Home' face. To view the cube from any face press the corresponding letter. This will bring the selected face to the centre of the cross, with the adjacent faces surrounding it. The selected face may then be rotated (with consequent effects on the adjacent faces) by the use of the > and < keys ('greater than' and 'less than' symbols). The SHIFT key need not be used when rotating. Each press of a rotate key gives one quarter of a turn.

If the instructions distract you they may be removed by pressing the SPACE-BAR. The current state of the cube becomes a part of the program, so you may store a cube on tape at any time in whatever mess you're in by exiting from the program with CONTROL C, (or the Reset 2 button for V4 users) and then taping as normal with the O function. G 1602 will then re-enter where you left off, or you can load the original program with the cube in the start position, which is something you can't do with a physical cube puzzle. As the program is in machine code with a memory mapped display, operation appears instantaneous and touch-typing cube race fanatics should be able to get up quite a speed.



NUMBERING THE CUBIES IN THIS APPARENTLY TOPSY TURVY WAY ALLOWS A STANDARD ORIENTATION FOR ALL THE FACES REGARDLESS OF WHICH IS BROUGHT TO THE CENTRE. THIS POINT IS DIFFICULT TO UNDERSTAND BUT WAS THE SINGLE MOST IMPORTANT INSIGHT WHEN WRITING THE PROGRAM

It may look illogical but it certainly works!



The faces as they appear at the start of the puzzle

Modifying It

Altering any program written for one machine in order to run it on another is a monumental task. It does not help when the program is in machine code and memory maps the VDU. However, it is certainly possible and an excellent way to find out exactly how much patience and determination one can muster, and is the ultimate test of the devotion of your near and dear. Highly recommended as an alternative to the more debilitating forms of insanity! In order to start you off with an entirely unjustified feeling of confidence the following notes on salient points have been especially fabricated.

Those who are happier working in BASIC will find it easiest to work from the flow charts, ignoring the machine code listing. The 'Face Table' data in addresses 1800H to 187CH will need to be placed in arrays. If possible the display should be memory mapped, as cube manipulation typically consists of multiple rapid moves interspersed with periods of nail-biting. A slow display will prove incompatible with retention of inspiration. See also notes below on how the face table and constant orientation layout work together.

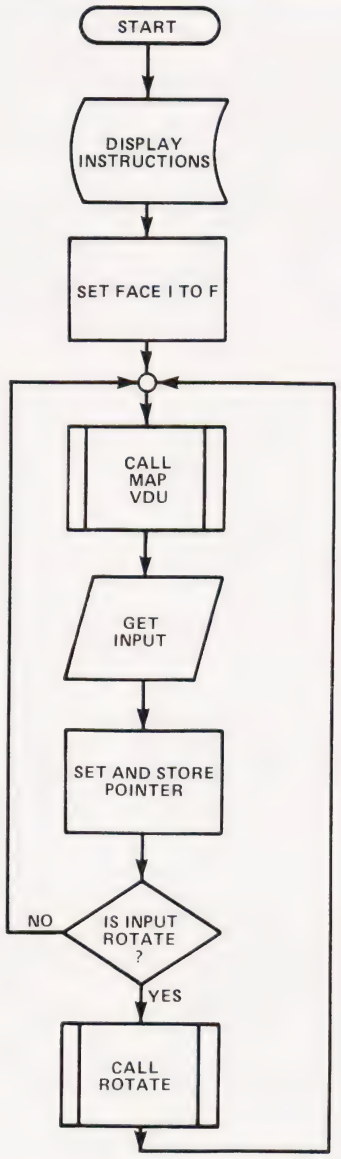
	00 – 09			0A – 0E
1800	FRONT FACE CUBIC STORE			FACE RELATIONS TABLES
1810	BACK	"	"	(INDICATES WHICH FACE GOES
1820	LEFT	"	"	WHERE WHEN ANY GIVEN FACE
1830	RIGHT	"	"	IS SELECTED AS FACE ONE)
1840	UP	"	"	
1850	DOWN	"	"	
1860	FACE ONE BUFFER			
1870	ADJACENT EDGE BUFFER			

This is the Face Table as stored in the program

The epicurean elite who prefer to work in machine code and possess Z80/8080 based computers will find it easier to alter the machine code to suit their own machines. Only two aspects of the program are likely to need changing: the subroutine calls to the Triton monitor, which should be substituted by appropriate utilities from the user's own monitor, and the VDU mapping, which is slightly more complex. This is based on a display of 16 lines of 64 characters which lives from 1000H to 1400H. Addresses are given below of the instructions which direct the display mapping to the specific display addresses. Your own choice of display addresses should be inserted, but first see the section on how the constant orientation layout works. Besides these display addresses being different, there is the possibility that a narrower layout, such as the NASCOM's 48 character width, will not accommodate the display as it is. This can be dealt with partly in the choice of display addresses above, and partly by reducing the number of pointer increments and decrements in Orient 1 and Orient 3. This should be done by replacing them with NOPs, and the appropriate addresses are given below. A similar remedy applied to some of the spaces (ASCII code 20H) will reduce the length of the credit line in the message string starting at 187DH. This credit line must *not* otherwise be interfered with as, due to the high level of loyalty for its creator which is inherent in this program, a malfunction notably lacking in subtlety will result! The rest of the message string may be dealt with as you wish. If possible the program should remain at the same address as it is here presented. Relocating it will involve changing not only all the call and jump addresses but also a large number of 'set pointer' addresses (instructions 21H and 11H). This last also precludes the use of relative jumps etc, to achieve relocatable code, unless you can figure a way to set pointers relatively. If you must put the program elsewhere the best way is to alter the first digit only of the addressing (2600, 3600, etc). Note that the program proper starts at 1602, the first two bytes are for the Triton tape function, to tell it where the end is.

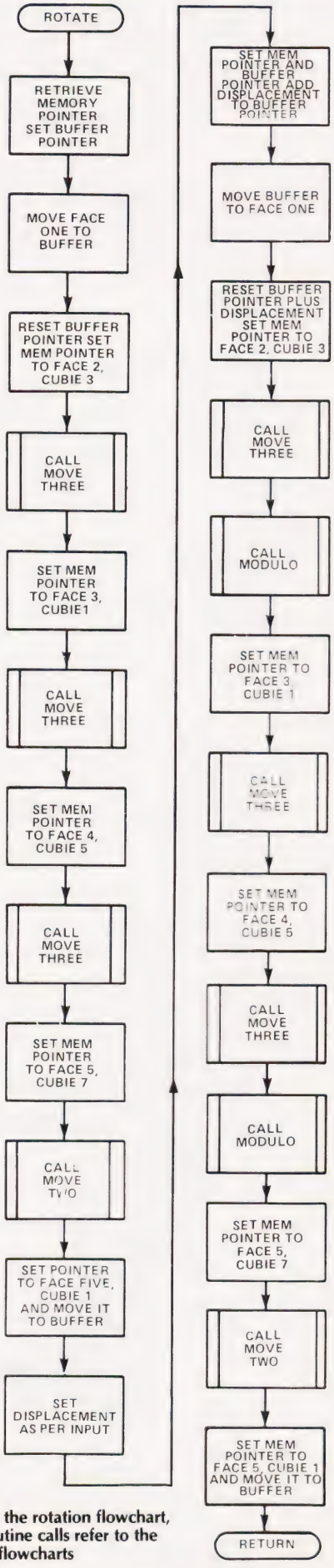
Face Saving

Each of the 16 byte lines of code from 1800H to 185FH holds information about one of the six faces of the cube.

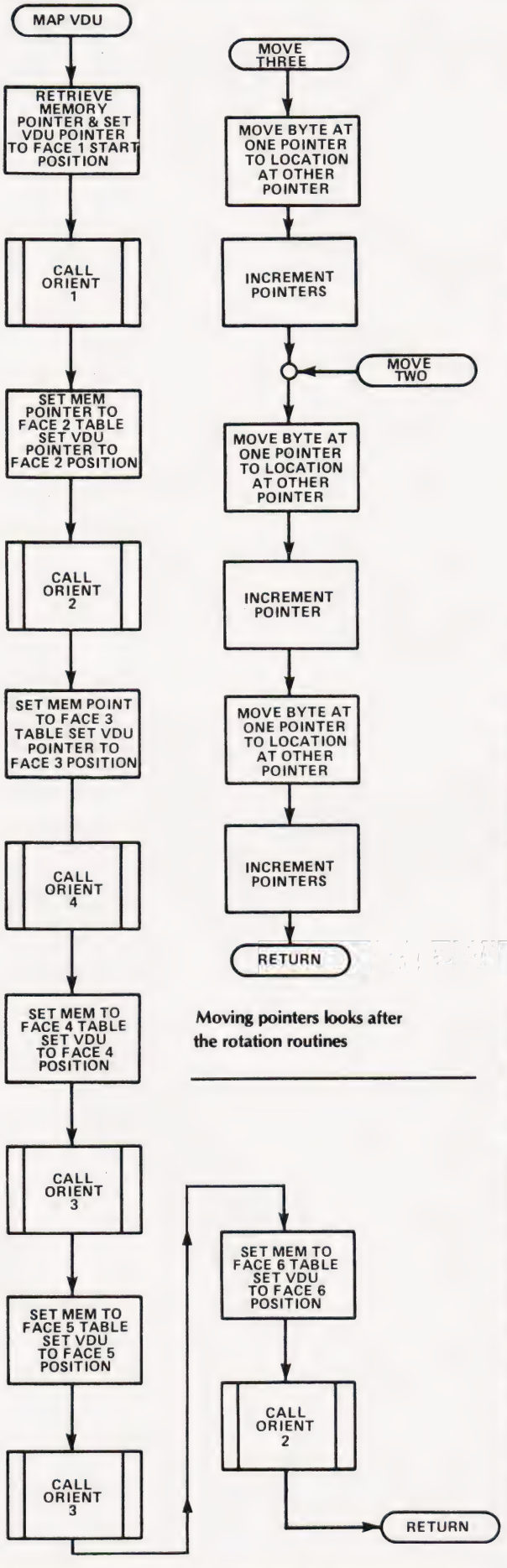


This is the 'main' flowchart for the program

Locations XXX0 to XXX7 contain the current facelets of outer eight cubies, XXX8 holds the end marker, XXX9 the centre facelet, which does not roam, and XXXA to XXXE hold a table of relationships which tells the program which of the faces is in position two, three and so on, when the face whose line we are dealing with is in position one of the constant orientation layout. Both the VDU routine and the rotate routine use this information, and the rotate routine also alters the contents of the first eight bytes as appropriate when a face is rotated. The constant orientation layout is necessary to allow the same rotate and VDU routines to be used whichever face is in position one and being rotated. No matter which face is in position one, the face in position two will present the same adjacent edge cubies, the third, fourth and fifth. Thus, the rotation routine always deals with locations XXX2, XXX3

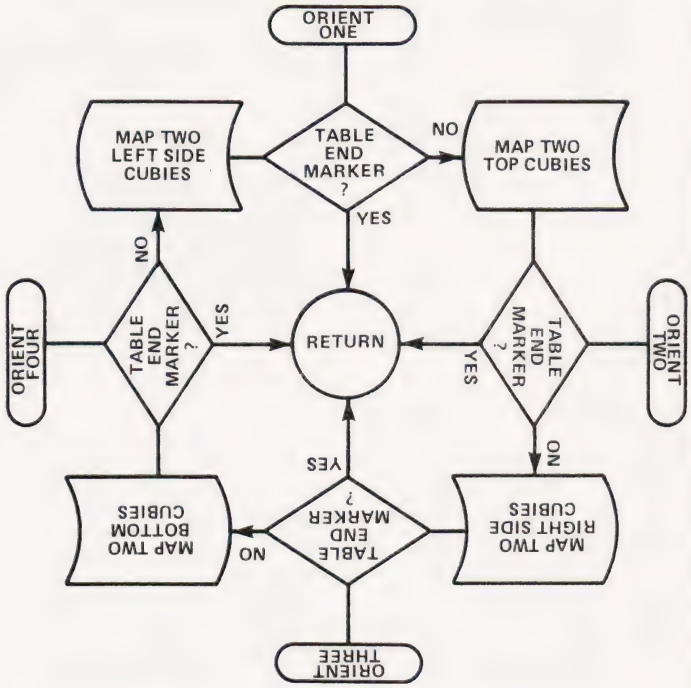


This is the rotation flowchart, subroutine calls refer to the other flowcharts

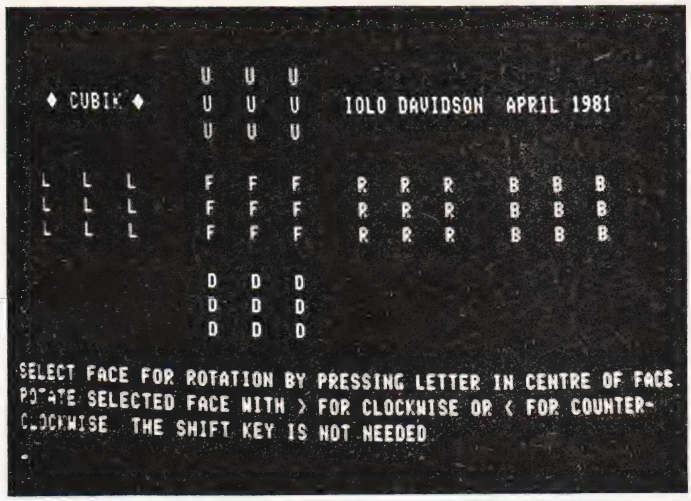


Mapping the VDU by accessing the face tables and the orientation routines

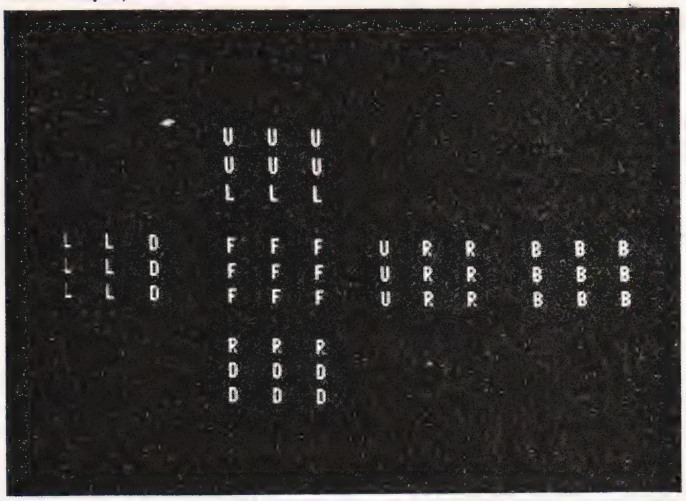
Moving pointers looks after the rotation routines



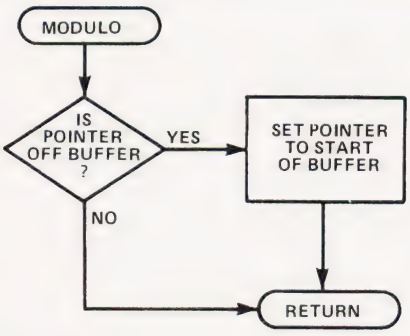
The Orient Express? Is this the world's first circular subroutine? Will it spin round if you blow on it?



Initial Display



The effect of one quarter turn clockwise on the front face. The instructions have been removed from the display with the space bar.



Making sure the pointer stays at the correct place in the buffer

and XXX4 in the table for the face designated as Face Two by the relationship table in the table selected as Face One. The orientation layout looks jumbled with its arrows pointing every which way, but that particular jumble stays the same whichever face is in the middle, which is the important point as far as the program is concerned. Try another layout which starts with all the arrows pointing up, then view it from another face. You will find that you get a different jumble each time. If you can follow that explanation, you will have no further difficulty adapting the program!

The VDU copes with the orientation layout by using a multiple entry circular subroutine for mapping each face onto the display. The return from this routine occurs when it has mapped eight characters, regardless of which corner the face is started at. So, by choosing the right entry point, the VDU routine can display any face whichever way up it needs to be in the layout: whichever face is in position two is displayed lying on its right side, for instance. This is done by setting the display pointer to the upper right corner of the face two VDU position, setting the data pointer to the table designated as Face Two, and calling Orient 2. On return the central facelet is mapped directly. Now that you understand what happens, here are the details, in the following format: Position of face in layout — Corner the display of that face starts with — Address in program in which to put the address of VDU position for that corner (two bytes, low order first) — Address in program in which to put address of VDU position of central facelet.

Face 1	Upper Left	1664H	166CH
Face 2	Upper Right	1673H	167BH
Face 3	Lower Left	1682H	168AH
Face 4	Lower Right	1691H	1699H
Face 5	Lower Right	16A0H	16A8H
Face 6	Upper Right	16AFH	16B7H

Addresses which should be altered to reduce the width of the faces themselves are 16C6H, 16CDH, 16E8H and 16EFH. Putting a 00 instruction in these locations will help reduce the display to fit a VDU width of less than 64 characters. Choice of VDU positions for the faces above is also important in this regard.

Monitor Calls

Three Triton monitor utilities are called by the program. These are pretty standard and comparable utilities should be available from the user's monitor. If not, the descriptions below will enable routines to be written.

Clear Screen (CD 08 00, found at 1602H and 1707H), clears the VDU display and resets the cursor.

Print String (CD 23 00, found at 1608H), prints a string on the display. Register pair DE has been loaded with the start address of the string, (187DH) which is sent to the VDU in in/out mode, not memory mapped. The routine returns when it reaches EOT market (04).

Keyboard Input (CD 0B 00, found at 1613H), waits for key to be pressed and returns with code in accumulator.

The following is a list of addresses of the subroutines referred to in the flowcharts:

1602	Start
1613	Main loop re-entry
1660	Map VDU
16C0	Orient 1
16D1	Orient 2
16E2	Orient 3
16F3	Orient 4
1707	Remove instructions
1710	Rotate
17C0	Move three bytes
17C4	Move two bytes
17D0	Modulo
17FE	Pointer store
1800	F face table
1810	B face table
1820	L face table
1830	R face table
1840	U face table
1850	D face table
1860	Face 1 buffer
1870	Adjacent edges buffer
187D	String (do not remove)
18C2	String continued (this portion may be removed)

References

For more information on cubology a good place to start would be 'Scientific American' magazine for March 1981, which has much information and references to other sources.

Program Listing

```
1600 70 19 CD 08 00 11 7D 18 CD 23 00 3E 46 00 00 00
1610 C3 16 16 CD 0B 00 21 30 16 BE CA 40 16 23 F5 7E
1620 FE 00 CA 29 16 F1 C3 19 16 F1 C3 13 16 00 00 00
1630 46 42 4C 52 55 44 3C 2C 3E 2E 20 00 00 00 00 00
1640 FE 20 CA 07 17 FE 3F FA 10 17 26 18 7D E6 0F 07
1650 07 07 07 6F 22 FE 17 CD 60 16 C3 13 16 00 00 00
1660 2A FE 17 11 12 11 CD C0 16 23 7E 32 56 11 23 00
1670 E5 6E 11 1A 10 CD D1 16 23 7E 32 56 10 E1 23 E5
1680 6E 11 A0 11 CD F3 16 23 7E 32 64 11 E1 23 E5 6E
1690 11 9A 12 CD E2 16 23 7E 32 56 12 E1 23 E5 6E 11
16A0 8B 11 CD E2 16 23 7E 32 47 11 E1 23 E5 6E 11 36
16B0 11 CD D1 16 23 7E 32 72 11 E1 C9 00 00 00 00 00
16C0 7E FE FF C8 12 23 13 13 13 13 7E 12 23 13 13 13
16D0 13 7E FE FF C8 12 23 3E 40 83 5F 7E 12 23 3E 40
16E0 83 5F 7E FE FF C8 12 23 1B 1B 1B 1B 7E 12 23 1B
16F0 1B 1B 1B 7E FE FF C8 12 23 7B D6 40 5F 7E 12 23
1700 7B D6 40 5F C3 C0 16 CD 08 00 C3 0B 16 00 00 00
1710 F5 2A FE 17 11 60 18 7E FE FF CA 24 17 12 23 13
1720 C3 17 17 00 23 23 E5 6E 11 70 18 23 23 CD C0 17
1730 E1 23 E5 6E CD C0 17 E1 23 E5 7E C6 04 6F CD C0
1740 17 E1 23 E5 7E C6 06 6F CD C0 17 E1 6E 7E 1B 12
1750 F1 E6 2F FE 2C CA 5E 17 01 09 02 C3 61 17 01 03
1760 06 2A FE 17 7D 80 6F 11 60 18 1A 77 13 23 7D E6
1770 0F FE 08 CC D9 17 7B FE 68 C2 6A 17 CD DE 17 00
1780 2A FE 17 EB 7B C6 0A 5F D5 21 70 18 7D 81 6F 1A
1790 5F 13 13 CD C0 17 D1 13 D5 1A 5F CD D0 17 CD C0
17A0 17 D1 13 D5 1A C6 04 5F CD C0 17 CD D0 17 D1 13
17B0 D5 1A C6 06 5F CD C4 17 D1 1A 5F 7E 12 C3 57 16
17C0 7E 12 23 13 7E 12 23 13 7E 12 23 13 C9 00 00 00
17D0 7D E6 0F FE 0C CC D9 17 C9 7D E6 F0 6F C9 3A 9D
17E0 18 FE 49 C2 F0 17 3A A2 18 FE 44 C8 00 00 00 00
17F0 3E E9 21 FE 17 77 23 F9 C3 F5 17 C2 60 17 00 18
1800 46 46 46 46 46 46 46 46 FF 46 40 30 50 20 10 00
1810 42 42 42 42 42 42 42 42 FF 42 20 50 30 40 00 00
1820 4C 4C 4C 4C 4C 4C 4C 4C FF 4C 50 10 40 00 30 00
1830 52 52 52 52 52 52 52 52 FF 52 00 40 10 50 20 00
1840 55 55 55 55 55 55 55 55 FF 55 30 00 20 10 50 00
1850 44 44 44 44 44 44 44 44 FF 44 10 20 00 30 40 00
1860 46 46 46 46 46 46 46 46 00 00 00 00 00 00 00 00
1870 52 52 52 44 44 44 4C 4C 4C 55 55 55 00 0A 20 20
1880 20 20 62 20 43 55 42 49 4B 20 62 20 20 20 20 20
1890 20 20 20 20 20 20 20 20 20 20 20 20 20 49 4F 4C
18A0 4F 20 44 41 56 49 44 53 4F 4E 20 20 41 50 52 49
18B0 4C 20 31 39 38 31 0D 0A 0A 0A 0A 0A 0A 0A 0A 0A
18C0 0A 0A 53 45 4C 45 43 54 20 46 41 43 45 20 46 4F
18D0 52 20 52 4F 54 41 54 49 4F 4E 20 42 59 20 50 52
18E0 45 53 53 49 4E 47 20 4C 45 54 54 45 52 20 49 4E
18F0 20 43 45 4E 54 52 45 20 4F 46 20 46 41 43 45 2E
1900 0D 0A 52 4F 54 41 54 45 20 53 45 4C 45 43 54 45
1910 44 20 46 41 43 45 20 57 49 54 48 20 3E 20 46 4F
1920 52 20 43 4C 4F 43 4B 57 49 53 45 20 4F 52 20 3C
1930 20 46 4F 52 20 43 4F 55 4E 54 45 52 2D 0D 0A 43
1940 4C 4F 43 4B 57 49 53 45 2E 20 54 48 45 20 53 48
1950 49 46 54 20 4B 45 59 20 49 53 20 4E 4F 54 20 4E
1960 45 45 44 45 44 2E 0D 0A 04
```

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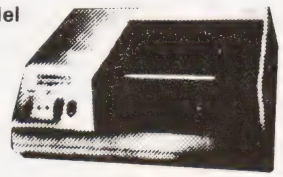

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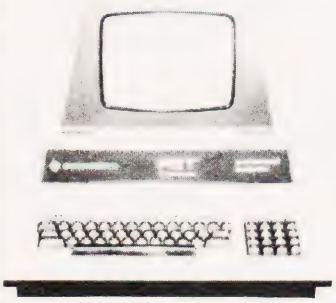

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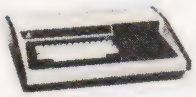

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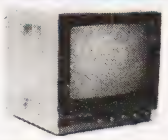

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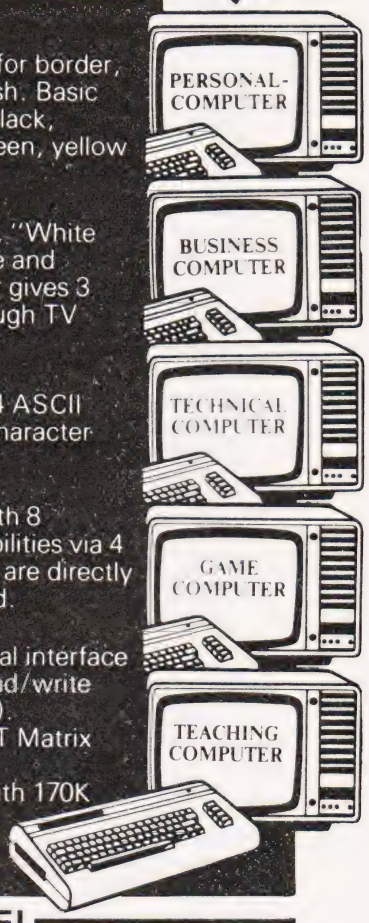

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DOUBLE SPEED CASSETTE

Phil Ogden

Uprate your Superboard to 600 Baud

Described here in detail is a very simple method of doubling up the speed of the Superboard II/Challenger 1P cassette interface from a speed of 300 Baud to a speed of 600 Baud. To readers interested in hardware this modification may seem trivial but it is hoped that Superboard owners who haven't yet become interested in hardware will take the plunge and find this method an excellent way of doing an awful lot, for very little work and for a matter of pence rather than a few pounds. Unlike the circuits that leave you wondering why you bothered to build them when the novelty has worn off, this modification will leave you wondering how you ever managed without it.

The Superboard II cassette interface has received much acclaim for its reliability — it works with the least expensive tape and the cheapest cassette recorders with hardly ever a complaint.

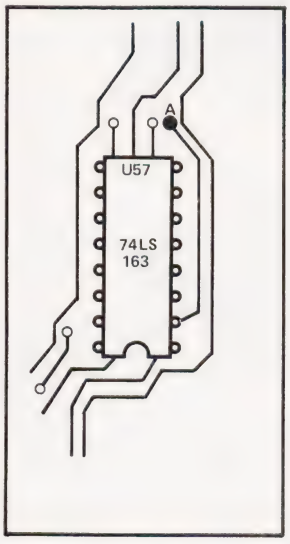

Fig. 1. This is the track layout at U57. Locate point 'A'.

This circuit does decrease reliability slightly when running at 600 Baud, but not to the extent where the interface would lose its lead over other machines. Good quality tape must be used: the danger is that cheap and nasty tape will *appear* to work perfectly for a period of time — up to several weeks in some cases — but then 'drop-outs' occur on the tape, with disastrous results (so that although 'Rollerball' loaded OK last week, today lines 200-302 are missing). If you use tape sold for computing use, the only difference will be to the speed of loading and saving programs and data. The error rate will still be negligible.

The Modification

All ICs are referenced by their numbers as given in the **Ohio Scientific User's Manual**. As a check, the numbers of the devices and their physical location on the board will be given. Diagrams will show convenient points for making connections (usually plated-through holes in the PCB).

Locate IC U57 — this is a 74LS163 and is the second IC to the right of the crystal on the board. Locate pin two of the IC — the track should look like that indicated in Fig. 1, and should pass through to the underside of the PCB via a hole (marked 'A' in the diagram). Follow the track through to the underside of the board. The foil pattern underneath should look like that shown in Fig. 2. — again, the hole 'A' is marked. Trace the track along the board and through the hole; this should go to pin 6 of IC U53, a 74LS157 located six ICs to the right of the crystal. Find hole 'B' as marked in Fig. 3, which is the point where the track from pin 6 of U53 passes through the underside of the PCB. Refer again to Fig. 2 and cut the track joining U57 and U53 at the place marked 'X' on the diagram, using a sharp knife and making sure that the cut is deep and wide enough to completely sever the electrical connection. Take a length of wire, push its end through hole 'A' (Fig.1) and solder it to the underside of the board, pushing the wire down firmly from the top side so that the insulation of the wire touches the PCB. This is to ensure that no bare wire is exposed, as that could cause problems if the wire ever became bent and shorted across a track. Solder the other end of the wire to pin 2 of the switch using the pin numbering convention shown in Fig. 4. In the same way, connect hole 'B' (as shown in Fig. 3) to pin 3 of the switch.

Locate U30, the 74LS163 below the prototype pads in front of the crystal. A circuit track can be seen protruding between pins 8 and 9 of the IC (see Fig. 5).

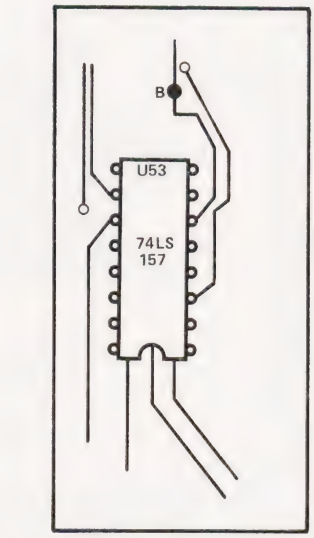

Fig. 3. The track you have just cut would have connected to U53 via the hole at point 'B'.

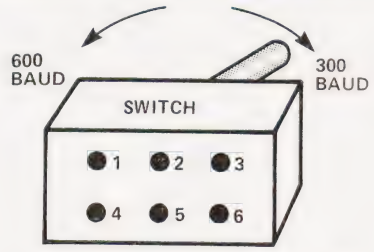

Fig. 4. The pin numbering scheme for the double pole changeover switch. Follow the text carefully when making the connections.

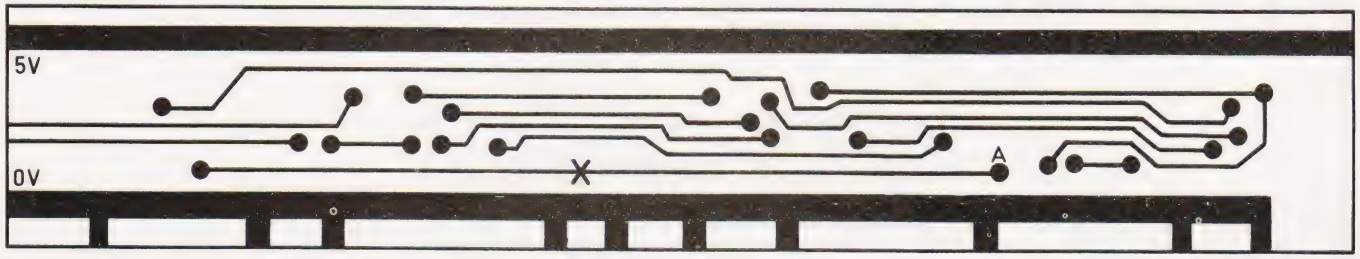

Fig. 2. The underside of the board at point 'A'. Cut the track at the 'X'.

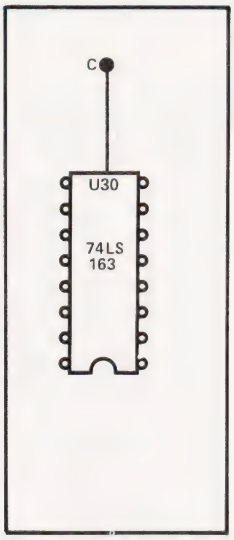

Fig. 5. Point 'C' has to connect to pin 1 of the switch.

This track actually comes from pin 11 but this is not obvious without close inspection — the diagram shows clearly which track is required. Where the track leads to the underside of the board (marked 'C' in Fig.5), solder a wire exactly as before and connect it to pin 1 of the switch. The first part of the circuit can now be tested. Plug the computer into its + 5 V supply and switch on the VDU. Type the following program in immediate mode:

```
SAVE:FORI=0TO9:I=0:PRINT"&";:NEXT
```

press (RETURN) and the program will start running. With the switch in the position closing pins 1 and 2, the program should run twice as fast as when the switch is in the position closing pins 2 and 3. Place a blank cassette in your recorder and enter this program on your Superboard:

```
10    SAVE
20    FOR I=1 TO 20
30    PRINT
40    NEXT I
50    FOR J=1 TO 10
60    FOR K=0 TO 128
70    PRINT CHR$(K);
80    NEXT K,J
90    FOR I=1 TO 20
100   PRINT
110   NEXT I
```

Run the program a few times with the switch in each position (and the recorder set to record). This will write strings of 129 characters to the tape, which will be used later for setting up the modification to the LOAD part of the cassette interface. If you play back these strings through a loudspeaker you will find that not only has the speed of the recording been doubled, but also the frequencies for '1' and '0' at 600 Baud are double those used for '1' and '0' at 300 Baud. Since doubling the frequencies again to run the interface at 1200 Baud would present problems with most cheap tape recorders (and all but the best tape) it is not possible to use this method reliably for speeds greater than 600 Baud

LOADing

To be able to interpret the higher frequencies used at 600 Baud, the receiver must also be modified by adjusting the potential applied to the capacitor connected across pins 6 and 7 of U69 (the 74LS123). This can be done by altering the setting of the potentiometer R57 (next to the tape/video socket at the back of the board), but fortunately there is an easier way which eliminates the need to 're-tune' the interface each time the speed is changed. Look carefully at the fixed resistor R53 which is immediately on the right of the potentiometer. If you are lucky, the wire leaving the top of the resistor will be connected to the potentiometer (via a PCB track, of course). If, however, the short wire leaving the bottom of the resistor is the one connected to the potentiometer, you will have to unsolder the resistor and re-solder it (or a new resistor) the other way around. Solder a wire onto the resistor at the point where the lead of the resistor leaves its top, and connect this wire to pin 4 of the switch. Connect pin 5 of the switch to the + 5 V rail at any convenient point (after the fuse and protective diode) and the main modification is complete.

Testing And Setting Up

Set the switch to 600 Baud (pins 1 and 2 and 4 and 5, connected) and play a portion of tape recorded earlier at 600 Baud. Type LOAD and watch the characters appear on the screen twice as fast as usual. Don't worry about the syntax error at the end of each string — after all, the computer is being loaded with nonsense! It should be obvious if the interface is not loading properly as the "@" symbol will keep appearing, or all the characters displayed will be the same instead of different. Switch to 300 Baud and attempt to load some of the characters recorded at that speed. If the recordings are not error-free, try adjusting the tone and volume controls on the cassette player, demagnetising and cleaning the heads, etc. If the LOAD operation is still prone to errors, adjust the potentiometer R57 on the computer board; a setting can be achieved that gives reliable results at both speeds. If things are still not loading properly, try changing the capacitor C11 (next to U69 — the 74LS123) to another one of slightly different value (even one of the same quoted value may work due to tolerance differences). Soon the interface should be working perfectly at both speeds, and thoughts can turn to various improvements.

Additions

It is a simple matter to add two LEDs to indicate the speed at which LOAD and SAVE will be performed. Solder a 220R resistor to pin 4 of the switch, and another to pin 6 of the switch. The other end of each resistor should go to LEDs — one red, and one yellow (see Fig. 6). Make sure that the resistors are connected to the anodes (+ve) of the LEDs. Solder the cathodes to earth. With the switch in one position, one LED should light — with the switch in the other position, the other LED should light; the colour convention is not imported (red is used here for 300 and yellow for 600). It is useful to label your cassettes with various coloured stickers so that you can tell at a glance which speed the tape was recorded at. A further possible modification would be to replace the switch with a relay under direct program control — it would then be possible to write a short machine code routine to identify the speed at which a tape was recorded, either by periodically changing speed and scanning the tape for a hearder, or switching the scanning speed each time a load error is encountered ("@" on the screen).

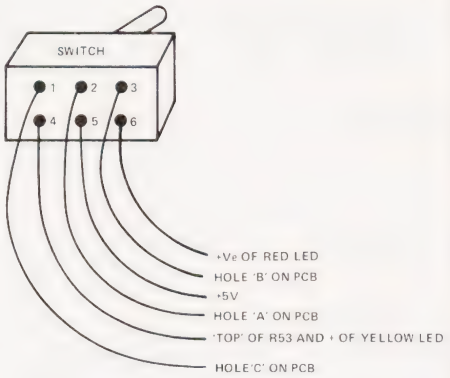

Fig. 6. A final check on the connections of the switch and the LEDs.

How It Works

The circuit supplies two different clock frequencies to the transmitter circuit one frequency is the usual one to give recordings at 300 Baud, and the other, taken from one stage higher up the master clock divider chain, is twice as fast as the original. Because the frequencies defining '1's and '0's are different, the switch also enables the frequency of the oscillation of the receiver to be changed so that recordings can be LOADed again without errors. Save all back-up copies of programs and data at 300 Baud — it's best to take no chances there!

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PROGRAMMING LANGUAGES

Dr G J Marshall

Our Language of the Month is LISP, the list processing language

LISP is a language for list processing. On the face of it, processing lists is not a particularly interesting or rewarding activity. Lists of items of any kind can be processed, however, so the language makes possible non-numeric computation. It provides a tool with which general symbol manipulation can be achieved. Further, the list provides a particularly general data structure with which many kinds of problem can be tackled in a rather 'natural' way. To give two examples of the uses of lists, sentences can be regarded as lists of words, while by consulting a list of obstacles and their locations a robot could automatically move freely within its environment.

It has been said that LISP is a difficult language to learn and several books have certainly made it appear so. Yet once its underlying concepts have been grasped it is revealed as not only an elegant language, but also a very powerful one which inspires its users to feel that they can achieve marvellous things with its aid. A little perseverance may be required to master it, but the effort is well worthwhile.

Language Development

LISP was developed by Professor John McCarthy and a group under his direction at the Massachusetts Institute of Technology in the early 1960s. Their original aim was to develop a programming system called the Advice Taker which could handle both facts and commands, using the facts in a commonsense way to help interpret and carry out the commands. The language was based on the lambda calculus and recursive function theory, two branches of mathematics which come together in the theory of computability. To achieve its aims, the language was developed as a vehicle for defining and transforming functions.

Workers in other areas soon realised that McCarthy's language provided the means of manipulating symbols that they were seeking. Symbol manipulation is the common requirement of many areas of investigation in computer science, including generalised problem-solving, robotics, pattern recognition, theorem proving, computational linguistics, game playing and algebraic manipulation. These areas are part of what is generally referred to as Artificial Intelligence, and as a result LISP has become the most widely used language in AI.

LISP is a functional language in the sense that it works by applying functions to inputs and delivers the corresponding result as the output. In a functional language, program structure is controlled essentially by the selection of the functions which, when composed, make up the overall function implemented by a particular program. Function selection is broadly equivalent to procedure and subroutine design in other languages.

Lists And Simple Programs

A list of the four items A, B, C and D is written in LISP as;

```
(A B C D)
```

It can be represented diagrammatically as shown in Fig. 1, which indicates that each item is stored with a pointer to the next item in the list. The pointer is usually implemented by storing with each item the address of the location containing the next item. The items of a list can be either atoms (elementary data) or other lists.

Fig.1. The list of items showing the pointers and the end of list marker at D.

Thus, the following list of three items gives the name and age of each of three people:

```
( (SMITH 21)  (JONES 18)  (THOMPSON 27) )
```

To illustrate the power of the list as a representation, the chess position shown in Fig. 2 can be represented by a list with an item for each piece on the board giving its value, colour and position, thus:

```
( (KING    WHITE   (4   7) )
  (KING    BLACK   (2   1) )
  (PAWN    WHITE   (4   3) )
  (CASTLE  BLACK   (1   1) ) )
```

A LISP program is written as a list. The first item in the list is a function. The remaining items in the list are arguments (or inputs) for the function. When presented with a program, LISP processes it by applying these three steps:

(i) the arguments are evaluated,
(ii) the function is applied to the evaluated arguments, and
(iii) the result of step (ii) is output.

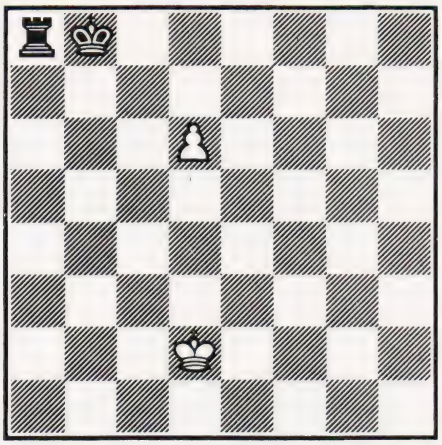


Fig.2. The chessboard positions represented by the items in the list.

Thus the program

```
(PLUS  2  3)
```

delivers the result 5. If values are assigned to A and B by

```
(SET  'A  6)
(SET  'B  7)
```

then:

```
(TIMES  A  B)
```

delivers the result 42. The quote symbol is used with the SET function, and elsewhere, to prevent evaluation: in this case we want to set A to 6 and *not* set the value of A to 6.

If values have been assigned to X, Y and Z, then the value of the expression X *Y + Z can be obtained with the program

```
(PLUS  (TIMES  X  Y)  Z)
```

Note that the order of precedence of the operations is controlled by the programmer and not automatically as would be the case in a scientific programming language.

LISP possesses a number of standard functions, including PLUS and TIMES. However, the language is not primarily for numeric applications, and the standard list processing functions CAR, CDR and CONS are more typical of LISP. They permit lists to be constructed and dissected.

The function CAR applied to a list delivers the first item in the list, while when CDR is applied to a list it delivers the list without its first item. Thus, after assigning a list to L with:

```
(SET  'L  '(A B C D) )
```

then:

```
(CAR  L)
```

delivers A while the result of

```
(CDR  L)
```

is (B C D). The second item in the list is

obtained by

```
(CAR  (CDL  L) )
```

While CAR and CDR enable lists to be taken apart, CONS permits them to be constructed. The arguments for CONS are an item and a list, and the effect of the function is to add the item to the beginning of the list. Thus, the result of

```
(CONS  'Q  L)
```

is the list (Q A B C D).

User-defined Functions

When the functions provided by LISP do not meet the programmer's needs, he can define his own functions. Naturally, therefore, LISP has a function for defining functions! The function which increases its argument by one, and which could be represented mathematically as

$$\text{add 1 (x)} = x + 1$$

is defined in LISP by

```
(DEFINE  (ADD1  X)  (PLUS  1  X) )
```

Once defined, the function can be used in the same way as standard LISP functions. Thus, the program

```
(ADD1  6)
```

gives the result 7.

Recursion

Powerful functions can be built by combining other functions. In this way, programs can be written that are remarkably short and compact for the computation that they perform. Recursion is one important technique in developing powerful functions. A function where definition partly involves itself is called recursive.

Before illustrating recursion it is necessary to introduce one or two further features of LISP. The function NULL is applied to a list. If the list is null, that is, if it contains no items, then the function NULL is true (T), otherwise it is false. Thus, after

```
(NULL  L)
```

the result of

```
(SET  'L  '(A B C) )
```

is false, while

```
(NULL  '( ) )
```

is always true.

The conditional function in LISP is COND and it takes the form:

```
(COND   (test 1   result 1)
        (test 2   result 2)
                ...
        (test n   result n) )
```

It corresponds to the perhaps more familiar structure . . . **if** test 1 **then** result 1 **else if** test 2 **then** result 2 **else if** . . .

The tests are made successively, and the result delivered is the one corresponding to the first successful test. The following program delivers the result zero if the list assigned to M is null and 1 otherwise:

```
(COND   ( (NULL  M)  0)
        (  T         1) )
```

We can now define a recursive function which takes a list as its argument and finds the number of items in the list. The function is based on the idea that the number of items in a list can be found in this way: **if** the list is null **then** the number of items is zero **else** the number of items is one (for the first item) plus the number of items in the rest of the list.

The function is defined by

```
(DEFINE  (ITEMS  L)
         (COND   ( (NULL  L)          0                    )
                 (  T       (PLUS  1  (ITEMS (CDR  L))))
                                                          ))
```

or by

```
(DEFINE  (ITEMS  L)
         (COND   ( (NULL  L)          0                    )
                 (  T       (ADD  1   (ITEMS (CDR  L))))
                                                          ))
```

A similar recursive function, which when applied to a list of numeric atoms finds the sum of all the atoms in the list, is defined by:

```
(DEFINE  (SUM  L)
         (COND ( (NULL  L)       0)
               (  T     (PLUS   (CAR  L)  (SUM  (CDR  L))))
                                                       ))
```

Having defined these functions, after

```
(SET  'L  '(3  7  9  4  2) )
```

the program

```
(ITEMS  L)
```

gives the result 5, while

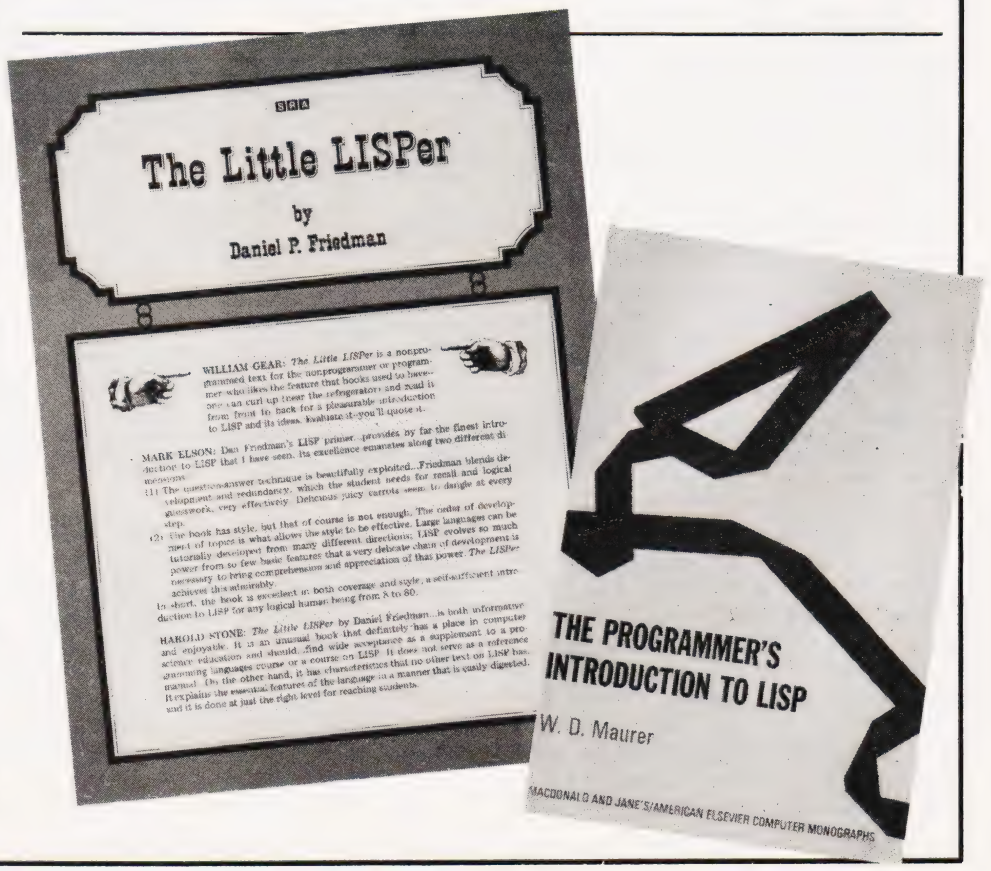
```
(SUM  L)
```

delivers 25.

Implementations

There is no shortage of implementations of LISP for microcomputers. Among those available, Commodore have a version for the PET, Owl Computers supply a version for the Apple, van der Wateren has written an implementation for 6800-based systems and Acorn have a 6K interpreter for the ATOM.

This article can do little more than introduce and give a flavour of LISP. To show why LISP is the dominant language among AI workers requires much more space. Winston's book 'Artificial Intelligence' (Addison-Wesley, 1977) gives an attractive introduction to many of the topics in AI, besides showing how LISP is used in practice. Additionally, this book provides the best introduction to LISP that I have found. 'The Little Lisper' by D P Friedman (SRA, 1974) is an entertaining introduction to LISP and to recursion. 'LISP for the M6800' was published by van der Wateren in Dr Dobb's Journal, No 28, pp 24-25. The article is not very enlightening, but it does describe the features of a particular implementation and it also gives details of how to obtain that implementation.



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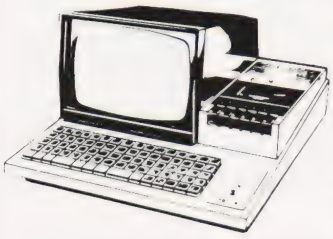

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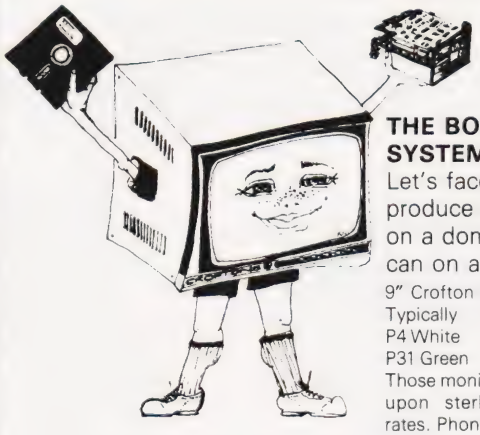

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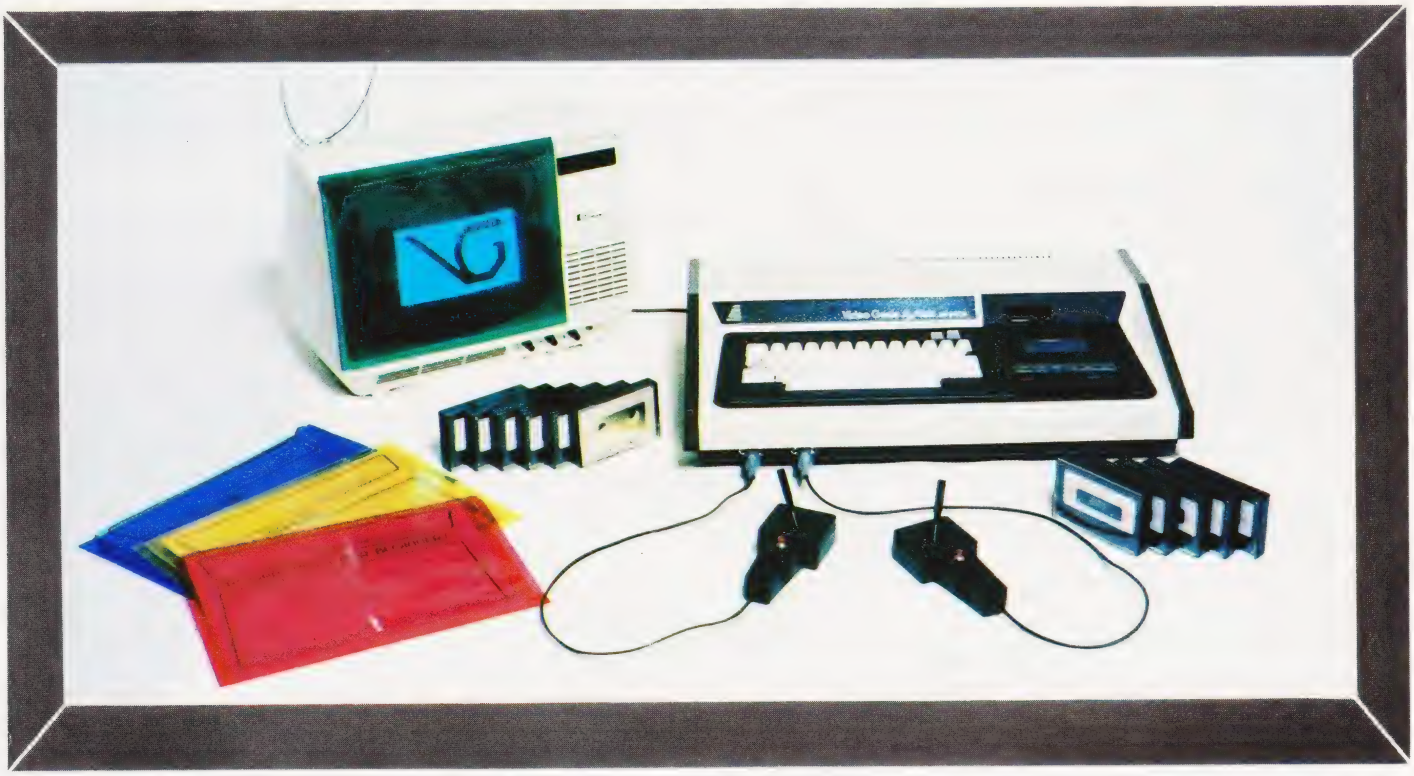

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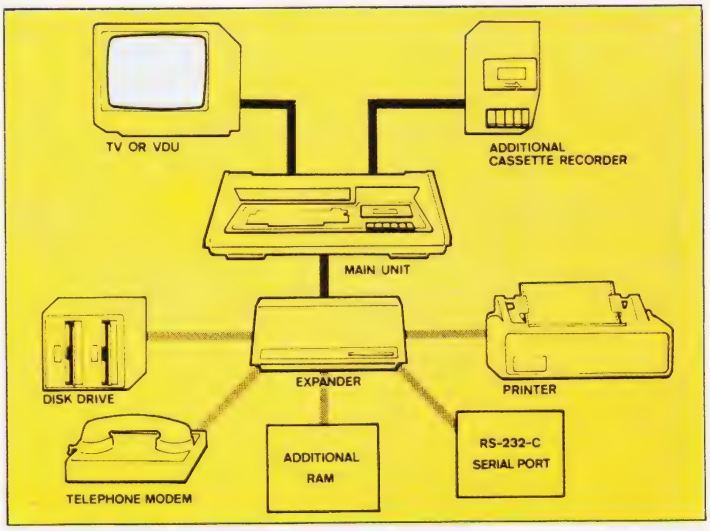

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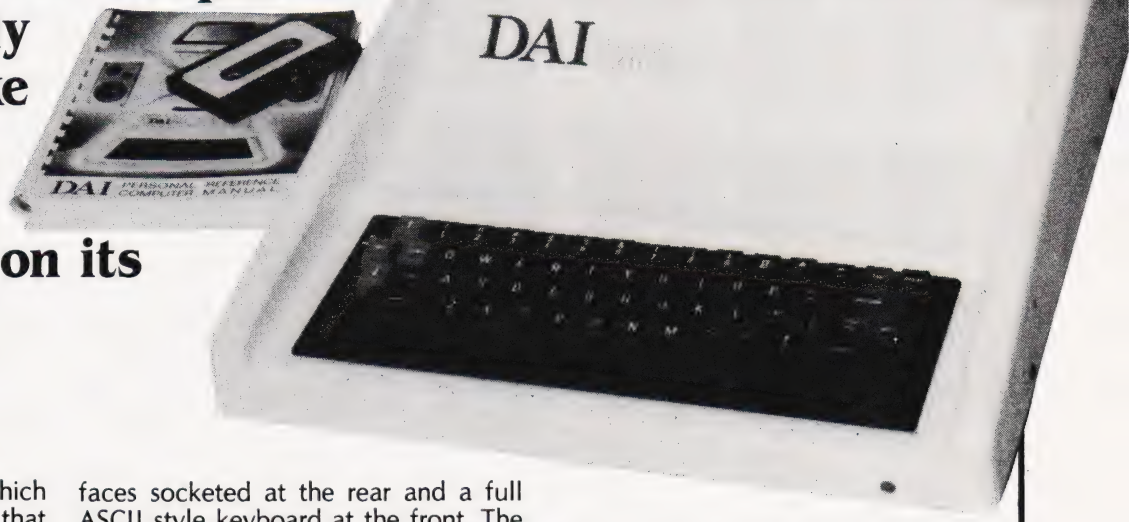


If a computer was produced which most closely meets the 'ideal' that people ask us to recommend, then the result would probably be a system not unlike the DAI Personal Computer. Certainly from the specification and the price (see Table 1) it appears to be a machine worthy of closer inspection.

The computer is produced by a Belgian company and is marketed in a number of European countries by subsidiaries, Data Applications (UK) Ltd of Cirencester being the British source. Its history is quite interesting. Texas Instruments wanted to launch a personal computer into the European market but their TI 99/4 machine was not compatible with the PAL TV system. They asked DAI to design and produce a computer using existing silicon stocks (hence the use of the 8080A), and the intention was to have the system ready for use in a Dutch TV computer literacy project. The design was not finalised in time, for a variety of reasons, and the Dutch decided to use the Exidy Sorcerer. Texas then chose to bring in the TI 99/4 with an American, NTSC, monitor and DAI were left with the developed, and paid for, computer which they now market themselves. Although it's quite well known in Europe, very few seem to have been bought in the UK. DAI here are mainly involved in industrial control systems.

Competition for the machine is mainly American, the Apple and Compucolor being the the obvious rivals. I shall not, however, attempt to draw any direct comparisons but merely detail the pros and cons of the DAI. If you are interested in a colour graphics computer for personal use then this system deserves a place on the short list with the two previously mentioned systems.

What You Get

The DAI is housed in a neat desktop case with all the connections for interfaces socketed at the rear and a full ASCII style keyboard at the front. The power switch is at the back but there is an LED at the front which indicates that the system is powered up. One rather nice touch is the reset switch, which can only be operated by a pointed instrument such as a pencil. This means that it is difficult to accidentally reset the system, but the manual does give a 'last rites' routine if you then decide that you didn't really want to kill it after all!

The case is one of the few areas open to criticism, in my opinion. It is simply too deep to fit on a normal desk with the TV behind it and you can't sit the TV on top because that would block the ventilation slots. If the keyboard was made separately to the main PCB it could be mounted on top and this would shorten the case to a more reasonable size. Only a minor niggle, but space is often at a premium especially when justifying it to the 'other half'!

Three leads are supplied: power, cassette and video together with a manual — of which more later. To avoid any possibility of faulting the graphics by using a TV that was unsuitable I also borrowed a Sony portable, the 'recommended' model. Experimentation proved that the graphics work just fine on any modern TV and they also produce a true 'grey scale' on a black and white set.

DAI supplied a cassette with a number of demonstration programs but I encountered a slight problem with loading them. A cassette machine was offered with the review machine but, because I possess one specifically for this type of work, I didn't bother with it. Whether my cassette is at fault, or whether there is a problem with the machine on which the programs were recorded, I don't know — but there were considerable struggles at times. One definite fault did show up, however. The cassette interfaces are relay controlled and the devices used are not up to the job. Cassette recorders with heavy duty motors, like mine, generate a large back EMF when the field current is broken and this can, and did, weld the contacts shut.

The problem can be solved by fixing a diode across the jack plug terminals but you will need to experiment to find the correct polarity.

Overall the package contains everything that one is likely to need to begin with. It would be nice to supply some demo programs as standard but several are given in the manual anyway. The manual itself contains two sections; the first is an 'idiot's guide' to getting it up-and-running, and the second part tries to be a complete reference work — and fails. What is needed is to produce a middle document that explains things in greater detail than the first but in less technical language than the second, something that DAI are in the process of doing. When this arrives the system should have some decent documentation; as it is, the quality is well below that of the hardware.

CPU	8080A (2 MHz)
RAM	48K
ROM	24K bank selected
I/O	Bi-directional RS232. DCE parallel bus. Two 600 baud cassettes. Two games paddles. Stereo sound
Graphics	Three resolution, four modes with up to 16 colours. Animate facility
BASIC	Extended, semi-compiling type
Sound	Four channels output in mono via TV or stereo to hi-fi
Monitor	Simple machine code monitor
Options	Range of DCE based interfaces. Maths chip (£149 + VAT). Floppy discs in the autumn (£600 + VAT approx)
Price	£595 + VAT

Table 1. The vital statistics of the DAI.

The Hardware

As shown in Table 1 the system is configured around an 8080A CPU running at 2 MHz. The architecture is fairly conventional except that bank select techniques are used to increase the amount of system software from a theoretical 16K to 24K. A block diagram of the system is given in Fig. 1 and the memory map is shown in Fig. 2.

The industrial background of the company reveals itself with the provision of numerous test points on the board and a full 8080 bus connector so maintenance should be quite simple. All the circuitry is crystal controlled, a total of three are used, and with the sole exception of the keyboard the layout is excellent.

The board sitting on top of the rear of the system is the video board, which can be interchanged to suit other TV standards or black and white monitors as required. The colour circuitry actually produces a true PAL standard so you can tape the proceedings on a VCR if you wish, an unusual feature. The quality of the picture produced and its stability have led to the Belgian TV service using it for subtitling purposes and I believe that one of the independent UK companies are also looking at the possibility.

All the details of the I/O connections are given in the manual including those of the DCE bus for those who feel adventurous. The optional maths chip, an AMD 9511, is treated as an I/O device.

BASIC commands are available to send and receive information through the bus as well as the paddle and cassette interfaces. The RS232 can be treated as a terminal or used to drive a printer, the latter is achieved by a single POKE command which copies everything sent to the screen to the RS232 port as well.

The Basics Of BASIC

Leaving aside the special features like the programmable sound and graphics which I will explain later, the BASIC is apparently similar to Extended Microsoft types. However, it is a semi-compiling variant which makes it considerably faster than a normal Interpreter (although not as fast as a true Compiler). As each line of code is typed in it is checked for syntax and on typing the RUN command the program is turned into a 'half-way' code which executes as a block rather than line-by-line. To go with this there are a number of debugging commands; TRON, TROFF and STEP as well as an excellent Editor.

Variables can be given names up to 14 characters long and the four usual types are allowed. Space must be reserved for strings and arrays with the CLEAR command and arrays must be DIMensioned, there is no OPTION BASE facility unfortunately. One interesting feature of the variables is that groups of them can be pre-defined. The command IMP, short for imply, is used to set defined variables to a defined state; IMP INT A-D would make variables A, B, C and D operate as integers: a similar function is available for floating point and string variables.

A special command, VARPTR, can be used to find the location of variables and arrays in memory, extremely useful for fast processing of lists etc.

A full list of the main BASIC commands and functions is given in Table 2, and the special graphics and sound commands will be further explored later.

Painting By Numbers

The DAI has a bewildering 12 possible graphics modes plus a text-only mode. The combinations are shown in Table 3. Each of the three stages of resolution is broken into four subsets; 4 or 16 colours, with or without text. In the split mode the picture is physically shifted up to allow four lines of text underneath, it can be retrieved by changing mode.

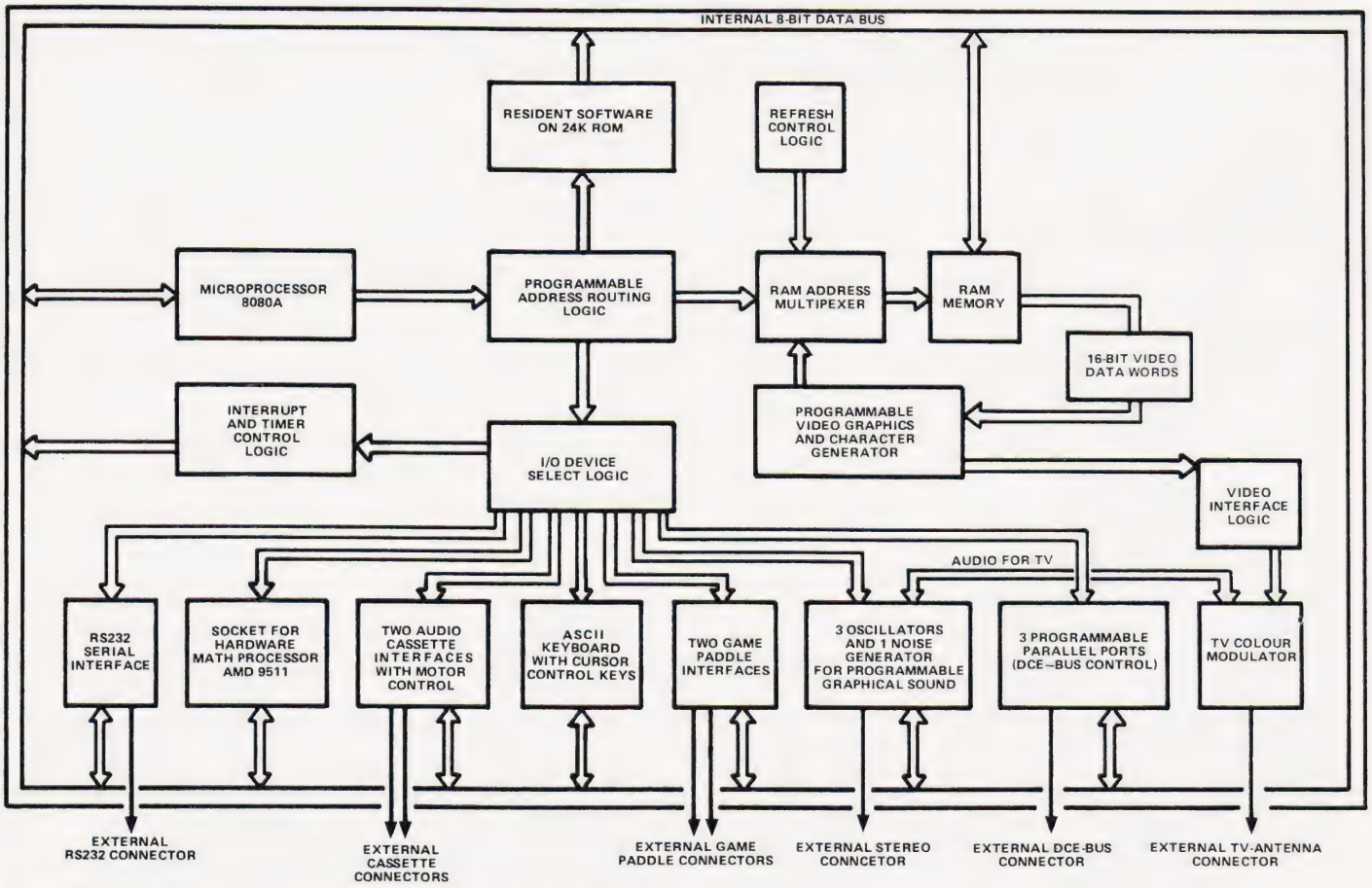
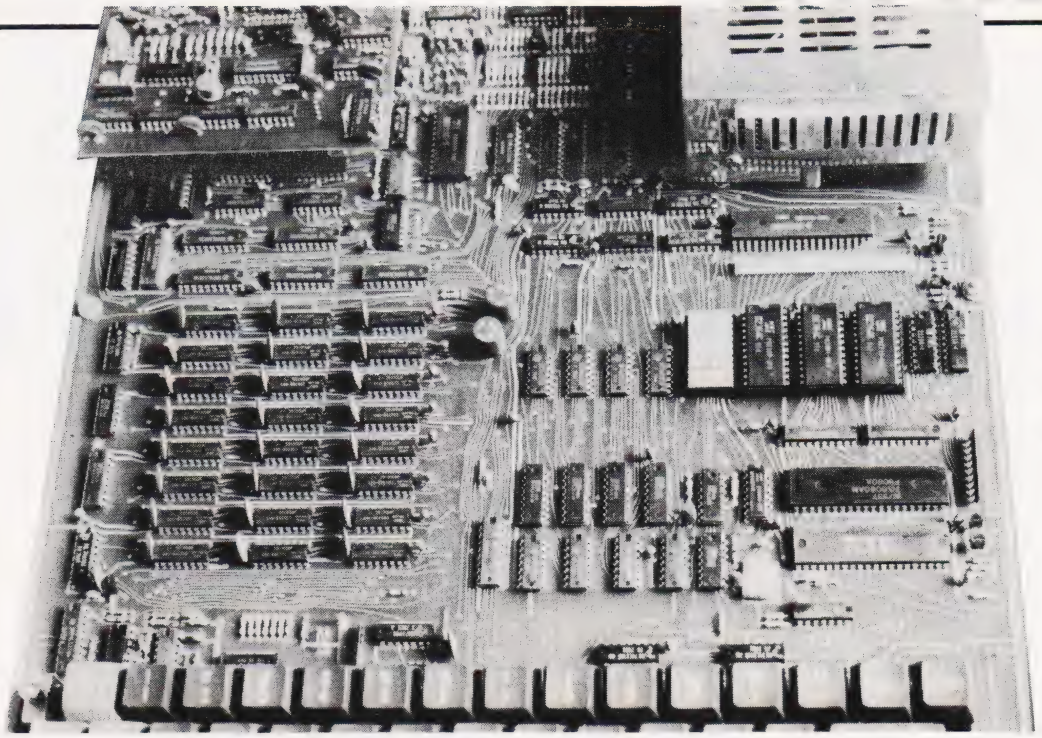


Fig.1. Hardware block diagram, all this is included in the basic system.



The main PCB area of the DAI showing the professional approach in the board layout. The light grey chip, centre right, is the optional maths device.

The commands are extremely simple to use in the 4-colour mode; 16-colour requires a greater amount of planning as, although you can display all the colours, restrictions do exist. The major restriction is that you can only display two colours (sometimes three) per each eight-dot field. As compensation for this the system offers an amazing animation facility where by changing colours parts of pictures disappear or appear instantaneously. You can even store 'frames' on tape.

The full set of BASIC commands for the graphics are shown in Table 4, with explanations.

BASIC Commands	
CHECK	Tape verification
CLEAR	Allocate variable space
COLORT	Set text colour
COLORG	Set graphics colours
CONT	As Microsoft
CURSOR	Position cursor
DATA	As Microsoft
DIM	As Microsoft
DOT	Set point on screen
DRAW	Draw line between two points
EDIT	Enter edit function
END	As Microsoft
ENVELOPE	Define sound 'shape'
FILL	Fills in defined square
FOR...NEXT	As Microsoft
GOSUB...RETURN	As Microsoft
GOTO	As Microsoft
IF...THEN/GOTO	As Microsoft
IMP	Pre-define variables
INPUT	As Microsoft
LIST	As Microsoft
LOAD	As Microsoft
LOADA	Load array from tape
MODE	Define graphics mode
NEW	As Microsoft
NOISE	Set up noise generator
ON...GOTO/GOSUB	As Microsoft
OUT	Outputs byte to DCE bus
POKE	As Microsoft
PRINT	As Microsoft
READ	As Microsoft
REM	As Microsoft
RESTORE	As Microsoft
SAVE	As Microsoft
SAVEA	Saves array on tape
SOUND	Defines sound channel characteristics
STOP	As Microsoft
TALK	Pseudo-speech
TRON	Trace on
TROFF	Trace off
WAIT	Pause facility
UT	Jump to machine code

BASIC Functions	
ABS	LOG
ACOS	LOGT
ALOG	MID$
ASC	PDL
ASIN	PEEK
ATN	PI
CHR$	RIGHT$
COS	RND
CURX	SCRN
CURY	SGN
EXP	SIN
FRAC	SPC
FRE	SQR
FREQ	STR$
GETC	TAB
HEX$	TAN
INP	VAL
INT	VARPTR
LEFT$	XMAX
LEN	YMAX

Table 2. BASIC commands and functions, see Tables 4 and 5 for more information.

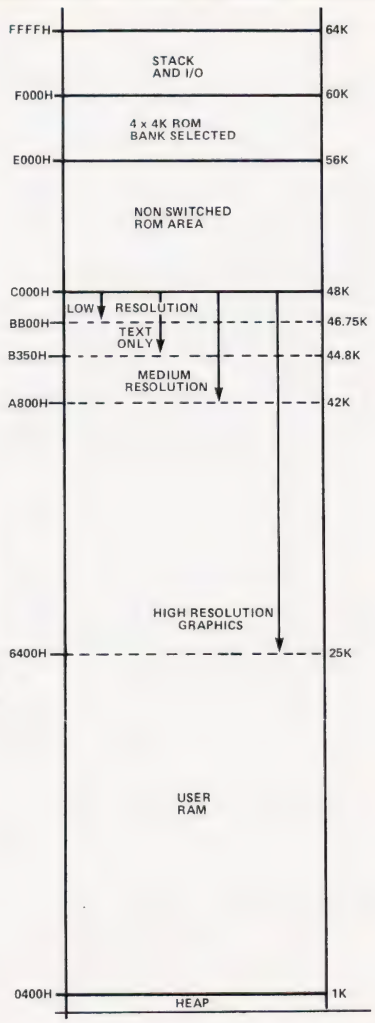


Fig.2. How the memory is arranged in the DAI.

Mode	Resolution	Text Area	Colours
0	—	24 x 60	2 of 16
1	72 x 65	—	16
1A	72 x 65	4 x 60	16
2	72 x 65	—	4 of 16
2A	72 x 65	4 x 60	4 of 16
3	160 x 130	—	16
3A	160 x 130	4 x 60	16
4	160 x 130	—	4 of 16
4A	160 x 130	4 x 60	4 of 16
5	336 x 256	—	16
5A	336 x 256	4 x 60	16
6	336 x 256	—	4 of 16
6A	336 x 256	4 x 60	4 of 16

The colours are:

0	Black
1	Dark blue
2	Purple red
3	Red
4	Purple brown
5	Emerald green
6	Khaki brown
7	Mustard brown
8	Grey
9	Middle blue
10	Orange
11	Pink
12	Light blue
13	Light green
14	Light yellow
15	White

Table 3. Quite a choice of modes and colours!

Sounding It Out

The BASIC supports a number of commands dedicated to the production of sounds, see Table 5 for the details. A total of four 'noises' can be simultaneously generated and these are output either through the TV sound channel or via the stereo DIN socket at the rear of the system.

Figure 3 shows the way in which the ENVELOPE command works, further manipulation of the command can cause the sound to repeat continuously. The volume level of the envelope is in fifteenths of the preset volume in the SOUND command. The sounds produced can be enhanced by the addition of NOISE or by modifying the tonal qualities by use of the Tremelo or Glissando options.

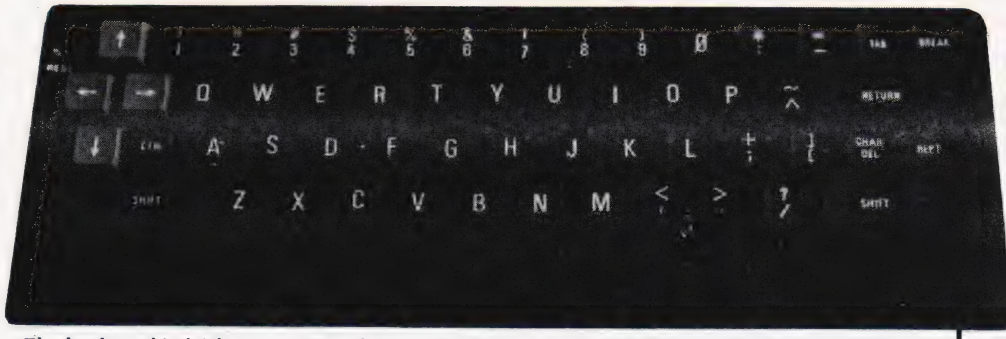
There is one further command, TALK. This actually looks to be the most interesting but there is, apart from a non-functioning sample program, no information given as to its use. Frustrating, in the extreme, but I expect that further experimentation will produce something.

The System Monitor

The machine code utility or monitor supplied with the DAI offers a fairly standard range of features; memory and register modification, block copying and tape read and write facilities all exist. The commands all work and the resulting machine code can be accessed from BASIC by the CALL instruction. The option exists to transfer a pointer into the HL register pair, which allows you to pass a BASIC variable to the machine code program.

COLORT a b c d	Defines background (a) and foreground (b) colours of text. The c and d variables are not used.
COLORG a b c d	Defines the four colours available in 4-colour mode. The first (a) is the current colour in 16-colour mode after changes.
DOT x,y c	Places a dot of current resolution at the specified x,y point in colour (c).
DRAW x1,y1 x2,y2 c	Draws a line in current dot size from one point to the other in colour (c).
FILL x1,y1 x2,y2 c	Fills in a rectangle between specified opposite corners in colour (c).
XMAX	The current maximum possible x displacement.
YMAX	The current maximum possible y displacement.
SCRN(x,y)	Returns colour of screen at specified point.
CURSOR n,m	Places the cursor at the nth position on mth line up from the bottom of the screen.
CURX	Returns current x (character) position of cursor.
CURY	As CURX but for the y (line) value.

Table 4. The special commands for graphics operations.



The keyboard is fairly conventional except for the recessed RESET button top left.

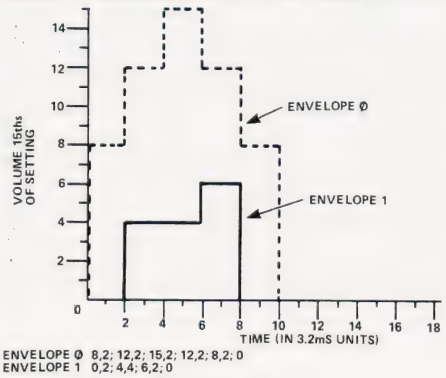


Fig.3. Creating envelopes for the sound channels.

While the facilities offered are nowhere near as comprehensive as those available of a dedicated machine code system they are more than adequate for use in writing short segments of code to speed up the graphics or create I/O driver routines. DAI offer an Assembler package for those interested in serious machine coding but, given the power of the BASIC, you probably won't need it.

Expanding Facilities

As yet the only hardware expansion options are the maths package and the range of Real World Cards for the DCE bus. The latter are mainly suited for industrial and research applications and are not priced to be attractive to the domestic user.

DAI have promised floppy discs by the autumn and a dual unit based of 5¼" drives, each holding 80K, will sell for about £600. The DOS will probably be CP/M 2.2 although this is not yet confirmed.

SOUND a b c d FREQ (e)	Defines the state of channel (a) which uses envelope (b), has volume (c) and tonal quality (d). The frequency is defined by the period (e) in Hz.
NOISE b c	Defines the state of the noise generator as above.
ENVELOPE a (v,t)	Defines the envelope shape used in the SOUND command. (v) is the volume and (t) is the number of time units. See Fig. 3.
TALK	Used for synthesis of 'vocal sounds'.

Table 5. How to get sound out of the system.

The games paddles are available but not from DAI. European support in terms of hardware seems to be better and it is likely to remain that way until the system starts to appear in quantity in the UK. Software support is virtually non-existent, with the exception of an active user group based in Belgium which produces a very nice newsletter and sells programs, assuming that you can read Flemish!

Conclusions

With one or two slight areas of criticism the DAI appears to offer a very acceptable alternative to the American dominated colour graphics market. Whether this will remain the case for much longer is a matter open to some doubt but if DAI were prepared to update the system slightly it should still remain competitive.

The areas in which I feel work is needed immediately are the manual and the cassette control. The former is already being undertaken, the latter should be a simple component change. The only other area open to personal criticism is the case design. If the keyboard was made separate the depth of the box could be reduced or restyled à la Apple, which would allow the monitor to sit on top. Perhaps they employed the Sirius Cybernetics Corporation?

Overall, though, the system offers a very good BASIC, extremely fast maths (with the hardware option), superb colour graphics although the 16-colour is at times a little awkward to use, and versatile sound generation. Whether you wish to get all this at once and pay the £595, or to buy a smaller system and build up is the choice that you will have to make. In theory the machine can be supplied with as little as 8K but this is not available in the UK. The only cheaper route to the same end is by buying a minimum Apple or ITT 2020 and adding the extra cards, but this is more expensive in the long run. No currently available British model offers the facilities available on the DAI *but* if you want to wait then the autumn will bring some home-grown opposition.

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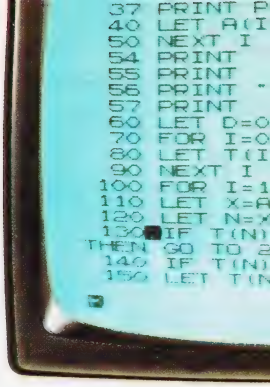

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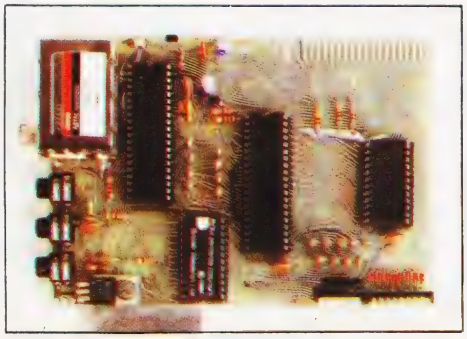

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SAVING BASIC STRING ARRAYS

P J Sanders

Dump string variable from NASCOM's BASIC with this routine

I have often thought it would be useful if string arrays could be saved as well as numeric arrays. An example of this use would be detailed entries of a bank balance that could be saved on a monthly basis. The following article is written for people who have a NASCOM with the 8K ROM BASIC V4.7 and NAS-SYS 1.

To see how this can be done, we must look at how BASIC stores its data (see Fig.1). The program lines are held in memory from Hex 10F9 onwards. When RUN is entered, the interpreter stores the variables after the end of the program lines and the variable arrays are stored after this. Numeric variables are set to 0 and string variables are set to zero length. BASIC tells the difference between numeric and string variables (and arrays) by setting the MS bit of the variable name when it refers to a string.

ie AA = 41 41, AA$ = C1 41

Fig.1 The areas set aside for storing BASIC programs and variables.

It was once thought that the MS bit of the name could reset to fool BASIC into thinking that it was a numeric array, and this could then be saved in the normal way. Of course, all that was saved were the pointers to the data. The data is held in one of two places: (a) Embedded in the actual program, ie

```
120  LET A$(0,0) = "HELLO"
```

where the pointer would point to the actual location of the "H" in the area of the program. This is fixed and not very useful; or (b) Placed on a dynamic stack, ie

```
120  INPUT A$(0,0)
```

where the string that is input is placed on a stack at the top of memory and the stack pointer is moved down to point to the next free location ready for the next string. This leads to a problem in that a normal program will have many string variables and these will be placed on the stack as required, not in order, so saving the stack area is not a solution (see Fig.2).

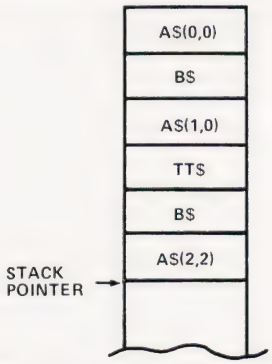
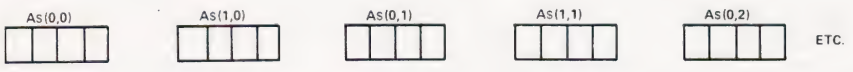
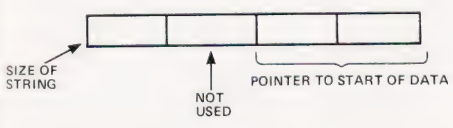


Fig.2 No order is maintained in the contents of the stack.

For arrays, information giving the size of the whole array, the number of subscripts (dimensions) and the size of subscripts follows the name. Next follow a number of four byte blocks, one for each part of the array, ie:



For numeric arrays the four bytes form an actual number but for string arrays the four bytes form a pointer to the data as follows:



The stack starts at the top of store allocated to BASIC and its size is allocated by the CLEAR command. The location of the current stack pointer is Hex 10C3.

A way round the problem of the mixed variables is to nominate one string array as the one to be saved on tape and to write its data to a buffer external to BASIC. The buffer could then be saved or loaded using the normal NAS-SYS read and write commands. To demonstrate the method a simple program is shown which saves a list of artists and their records, ie

1. Pink Floyd Dark Side of the Moon
2. Genesis Trick of the Tail

These are saved as two items per line and 10 lines in the form:

```
A$(0,1)  A$(1,1)
A$(0,2)  A$(1,2)        etc.
```

This could be expanded to more dimensions allowing for more items per line and to more lines, depending on the size of buffer. The length of each item is fixed to make the pointers easier to set up and use. Variable length strings could be used but then the pointers need to be saved alongside the data (ie reset the MS bit of the name and save as a numeric array). Pointers in the program that need explaining are as follows:

LINE

110 L0 = length of artist's name
L1 = length of record name
LN = number of lines
LT = total chars per line
BF = buffer start address (see later)

130,140 B0 and B1 are set up in this way to avoid embedded data

150 TS = temporary store for the stack pointer
DOKE 4291,BF sets up the stack pointer to point to the buffer for use with A$

200 Return the normal stack pointer

3040 DOKE 3084,−32000 loads ARG1 with buffer start address (see later)
DOKE 3086,−31488 loads ARG2 with buffer end address (see later)
DOKE 4100,1256 sets up the NAS-SYS write routine for the USR call, N is a dummy variable.

4030 DOKE 4100,1630 sets up the NAS-SYS read routine
POKE 3115,82 loads ARGX with an "R" or the read routine will do a "verify" on the data instead of loading it.

10000 DOKE 4291,BF−J*LT-LN(I)
This sets the stack pointer to the correct part of A$(I,J)

10110 This makes sure that the string is always the right length for loading A$

10140 Same as above

An area must be set up for the buffer, preferably external to BASIC. I have

memory to Hex 9000, but I use Hex 8600 and above for an operating system so I reserved Hex 8300 to 8500 for the buffer. BASIC was limited to Hex 8000 by answering Memory size? with 32768.

Stacks move downwards in store as they are used so the start of buffer pointer BF points to the top of the buffer. In this case it was set to 34000 which is within the limits of the buffer. This had to be converted to a negative number for the DOKE command by subtracting 65536 from it (line 110). The NAS-SYS read and write commands use ARG1 and ARG2 as pointers to the area they are using, and in this case

ARG1 = Hex 8300 or dec 33536 (−3200 for DOKE)
ARG2 = Hex 8500 or dec 34048 (−31488 for DOKE)

Program Listing

```
100   CLEAR 1000:DIM A$(1,10)
110   L0=14:L1=22:LN(0)=0:LN=10
120   LN(1)=14:LT=36:BF=34000-65536
130   FOR I=1 TO L0:B0$=B0$+" [SPC]":NEXT
140   FOR I=1 TO L1:B1$=B1$+" [SPC]":NEXT
150   TS=DEEK(4291):DOKE 4291,BF
170   FOR I=0 TO LN
180   A$(0,I)=B0$:A$(1,I)=B1$
190   NEXT I
200   DOKE 4291,TS
499   REM**FUNCTION CHOICE
500   CLS:PRINT:PRINT:PRINT
510   PRINT TAB(15);"1. INPUT LIST"
520   PRINT TAB(15);"2. DISPLAY LIST"
530   PRINT TAB(15);"3. CHANGE ITEM"
540   PRINT TAB(15);"4. SAVE BUFFER"
550   PRINT TAB(15);"5. LOAD BUFFER"
560   PRINT TAB(15);"6. END PROGRAM"
570   PRINT
580   PRINT "ENTER NUMBER OF FUNCTION";
590   INPUT "REQUIRED";N
600   IF (N<1)+(N>6) THEN GOTO 500
610   CLS
620   ON N GOTO 1000,2000,6000,3000,4000,5000
999   REM**INPUT LIST
1000  FOR J=1 TO LN:GOSUB 10100:NEXT J
1010  GOTO 500
1999  REM**DISPLAY LIST
2000  FOR I=1 TO LN:PRINT I;
2010  PRINT A$(0,I);TAB(20);A$(1,I)
2020  NEXT I:PRINT:PRINT
2030  INPUT "PRESS 'N/L' TO RETURN TO MENU ";N
2040  GOTO 500
2999  REM**SAVE BUFFER ON CASSETTE
3000  PRINT:PRINT:PRINT
3010  PRINT "PUT CASSETTE INTO RECORD MODE"
3020  INPUT "AND PRESS 'Y' WHEN READY";N$
3030  IF N$<>"Y" GOTO 500
3040  DOKE 3084,-32000:DOKE 3086,-31488
3050  DOKE 4100,1256:N=USR(N):PRINT:PRINT
3060  PRINT "TURN OFF CASSETTE AND PRESS"
3070  INPUT "'N/L' TO RETURN TO MENU";N
3080  GOTO 500
3999  REM**LOAD BUFFER FROM CASSETTE
4000  PRINT "TURN ON CASSETTE AND PRESS"
4010  INPUT "'Y' WHEN READY";N$
4020  IF N$<>"Y" GOTO 500
4030  DOKE 4100,1630:POKE 3115,82:N=USR(N)
4040  PRINT:PRINT
4050  PRINT "TURN OFF CASSETTE AND PRESS"
4060  INPUT"'N/L' TO RETURN TO MENU";N
4070  GOTO 500
4999  REM**END PROGRAM
5000  PRINT:PRINT:PRINT
5010  PRINT "THANKS AND GOODBYE"
5020  PRINT:END
5999  REM**MODIFY ENTRY
6000  PRINT:PRINT:PRINT
6010  PRINT "ENTER NUMBER OF ITEM TO"
6020  INPUT "BE CHANGED";J
6030  IF (J<1)+(J>10)+(INT(J)<>J) GOTO 6000
6040  PRINT:PRINT
6050  PRINT "DATA TO BE CHANGED:-"
6060  PRINT "ARTISTS' NAME ";A$(0,J)
6070  PRINT "RECORD ";A$(1,J)
6080  PRINT:PRINT:GOSUB 10100:GOTO 500
9999  REM**WRITE TO BUFFER
10000 TS=DEEK(4291):DOKE 4291,BF-J*LT-LN(I)
10020 A$(I,J)=BS$:DOKE 4291, TS:RETURN
10099 REM**OBTAIN DETAILS
10100 INPUT "NAME OF ARTIST(S) ";BS$
10110 BS$=LEFT$(BS$+B0$,L0)
10120 I=0:GOSUB 10000:BS$=B0$
10130 INPUT "NAME OF RECORD";BS$
10140 BS$=LEFT$(BS$+B1$,L1)
10150 I=1:GOSUB 10000:BS$=B1$
10160 RETURN
```

PRECISION TIMING FACILITIES FOR THE Z-80

B I Lord, M A

Keep in time with your CPU

When using a microprocessor to interpret input signals in real time, the most interesting feature of a signal being measured is often its duration. Examples of this include measurement of analogue quantities (eg where the time between two signals indicates the rate of rotation of an object), digital filtering (eg keyboard debounce) and software processing of serial data (eg decoding of the Rugby MSF time signal). The routine given below monitors an input port for a specified combination of bits until that combination is seen. It returns the time (in milliseconds) which elapsed before that combination occurred. When the routine is called, a time-out period is also specified (ie a period after which the routine should abandon searching for the specified condition). This removes

the possibility of a 'hang-up' when the required condition is never met.

Accuracy

To achieve accurate timing (the resolution is one millisecond) both the inner loop, starting at READLOOP, and the outer (1 mS) loop, starting at MSLOOP, must be padded with extra instructions to give the desired execution time overall. The number of cycles of the inner loop in each millisecond can also be varied (line 2 in the listing). Since the padding and loop count required depend on the processor clock frequency it is useful to derive a general formula to aid in choosing these variables.

The time taken for one cycle of the outer loop is:

$$T_{outer} + nT_{inner}\text{-}J$$

where n is the number of cycles of the inner loop, T_{outer} is the time to execute the rest of the outer loop and J is the difference between the two possible execution times for DJNZ (at the end of the inner loop).

If we now include the time (P) added by the padding instructions then we have:

$$T_{total} = T_{outer} + P_{outer} + n(T_{inner} + P_{inner})\text{-}J$$

Values for the execution times of the instructions involved can be obtained from the Z80 CPU Manual, and using these we obtain:

T_{outer} = 75 T cycles
T_{inner} = 67 T cycles
J (a constant) = 13 - 8 = 5 T cycles

Substituting these we obtain:

$$P_{outer} + n(67 + P_{inner}) = T_{total}\text{-}70$$

T_{total} is the number of T cycles in 1 mS for the particular clock rate of our processor.

Examples

If our clock frequency is 1 MHz (T_{total} = 1000) then we have a result of 3 using the equation above. Unfortunately there are no Z80 instructions which take less than 4 T cycles so another solution must be sought! A good solution is n=12, P_{outer}=6, P_{inner}=10. Instructions LD BC, nn and INC BC have the correct timing and can be inserted into the code at lines 9 and 15 without affecting the logical action of the routine. (Insert 01 99 99 at line 9 and 03 at line 15. Also change line 2 to 06 0C). For a clock of 2 MHz one solution is n=25, P_{outer}=5, P_{inner}=10. In this case insert LD BC,9999 again at line 9 and RET Z (C8) at line 15. The zero flag is never set at this point and so no return will occur. For a 4 MHz clock a good solution is n=53, P_{outer}=8, P_{inner}=7. In this case insert LD C,99 (0E 99) at line 9 and two NOP's (00 00) at line 15. Also change line 2 to 06 35 and the relative jump on line 12 to 10 F3.

By using the general formula given, readers using different clock frequencies can derive a solution for their own particular cases. Note that the routine can be used simply as an accurate delay by using the time-out action and seaching for a condition which is know never to occur. Users of NASCOM 1, for example, can search for bit 2 on port 2 since setting of this bit (UART parity error) has been suppressed.

Program Listing

```
@ PARAMETERS:
@ PORT NUMBER (IN REGISTER C)
@ THE VALUE TO BE SOUGHT AT THE PORT (IN REGISTER D)
@ A MASK TO INDICATE WHICH BITS ARE RELEVANT (IN
  REGISTER E)
@ A 'TIMEOUT' VALUE IN MILLISECONDS (IN REGISTER HL)
@ (NOTE THAT HL=0 GIVES THE MAXIMUM TIMEOUT PERIOD
  OF 65.536 S)

WAIT FOR PORT: DD 21  00  00  LD IX,0000      @ 01 INITIALISE TIME
                                                  COUNT
MSLOOP:        06  19         LD B,25          @ 02 25 CYCLES OF
                                                  INNER LOOP
                                                  REQUIRED WHEN
                                                  CLOCK IS 2 MHz
READLOOP:      C5             PUSH BC          @ 03 SAVE B,C
               ED  78         IN A,(C)         @ 04 READ PORT
               4F             LD C,A           @ 05 SAVE VALUE
                                                  READ IN C
               AA             XOR D            @ 06 COMPARE WITH
                                                  'VALUE SOUGHT'
                                                  (MAKING ZEROES
                                                  WHERE BITS
                                                  AGREE)
               A3             AND E            @ 07 FORCE
                                                  IRRELEVANT BITS
                                                  TO ZERO
               79             LD A,C           @ 08 SAVE VALUE
                                                  READ IN A (FOR
                                                  POSSIBLE USE BY
                                                  THE CALLING
                                                  ROUTINE)
                                                @ 09 PAD HERE FOR
                                                  CLOCKS OF
                                                  1,2,4, MHz
               C1             POP BC           @ 10 RESTORE B,C
               C8             RET Z            @ 11 RETURN IF
                                                  CONDITION
                                                  SATISFIED (N.B.
                                                  CARRY WAS
                                                  CLEARED BY
                                                  'AND E')
               10  F2         DJNZ READLOOP    @ 12 OTHERWISE
                                                  CONTINUE
                                                  CHECKING PORT
               DD 23          INC IX           @ 13 1 mS ALMOST
                                                  COMPLETE
                                                  -INCREMENT
                                                  TIME COUNT
               C5             PUSH BC          @ 14 -SAVE C
                                                @ 15 -PAD HERE FOR
                                                  CLOCKS OF
                                                  1,2,4 MHz
               01  01  00     LD BC,0001       @ 16 -DECREMENT
                                                  TIMEOUT COUNT
               ED 42          SBC HL,BC        @ 17 -(USE SBC SO
                                                  THAT FLAGS ARE
                                                  SET)
               C1             POP BC           @ 18 -RESTORE C
               20  E4         JR NZ,MSLOOP     @ 19 -NEXT
                                                  MILLISECOND IF
                                                  NOT TIMEOUT
               37             SCF              @ 20 INDICATE THAT
                                                  TIMEOUT
                                                  OCCURRED
               C9             RET              @ 21

@ ON RETURN:
@ A CONTAINS THE LAST VALUE READ FROM THE PORT
@ IX CONTAINS THE TOTAL TIME WAITED (MILLISECONDS)
@ HL CONTAINS THE TIME REMAINING BEFORE TIMEOUT
@ C,DE,IY ARE UNCHANGED
@ IF TIMEOUT OCCURS THEN CARRY IS SET, OTHERWISE IT IS
  CLEARED

EXAMPLE:

    TO SEARCH FOR BIT 1 SET, BIT 0 UNSET ON PORT 7,
    IGNORING ALL OTHER BITS AND TIMING OUT AFTER
    ONE SECOND:-

    LD C,7
    LD DE,0203          @ MASK=03 i.e. BITS 0,1
                          RELEVANT
    LD HL,1000          @ DECIMAL 1000 mS
    CALL WAIT FOR PORT
    JR C, TIMEOUT
```

TTLs by TEXAS

7400	11p
74S00	60p
7401	12p
7402	12p
7403	14p
7404	14p
7405	18p
7406	30p
7407	30p
7408	16p
7409	16p
7410	15p
7411	20p
7412	20p
7413	30p
7414	40p
74C14	90p
7416	27p
7417	27p
7420	17p
7421	30p
7422	22p
7423	25p
7425	30p
7426	30p
7427	30p
7428	30p
7430	17p
7432	30p
7433	30p
7437	30p
7438	30p
7440	17p
7441	70p
7442A	50p
7443	112p
7444	112p
7445	80p
7446A	93p
7447A	60p
7448	80p
7450	17p
7451	17p
7453	17p
7454	17p
7460	17p
7470	36p
7472	30p
7473	32p
7474	30p
7475	38p
7476	32p
7480	50p
7481	100p
7482	84p
7483a	60p
7484	100p
7485	110p
7486	30p
7489	210p
7490A	30p
7491	80p
7492A	40p
7493A	30p
7494	84p
7495A	60p
7496	50p
7497	180p
74100	100p
74107	34p
74109	55p
74116	100p
74118	100p
74119	100p
74120	110p
74121	34p
74122	48p
74123	60p
74125	60p
74126	60p
74128	60p
74132	60p
74136	60p
74137	50p
74141	75p
74142	200p
74145	90p
74147	120p
74148	100p
74150	120p
74151A	50p
74153	50p
74154	90p
74155	60p
74156	60p
74157	50p
74159	120p
74160	70p
74161	70p
74162	70p
74163	70p
74164	90p
74165	90p
74166	90p
74167	200p
74170	200p
74172	300p
74173	90p
74174	75p
74175	75p
74176	70p
74177	90p
74178	100p
74180	80p
74181	160p
74182	90p
74184A	120p
74185	120p
74186	500p
74188	325p
74190	90p
74191	90p
74192	90p
74193	90p
74194	90p
74195	95p
74196	95p
74197	80p
74198	120p
74199	120p
74221	90p
74251	100p
74259	120p
74278	200p
74279	110p
74283	140p
74284	250p
74285	250p
74290	100p
74293	100p
74298	100p
74365	60p
74366	60p
74367	60p
74368	60p
74390	100p
74393	120p
74490	150p

74LS SERIES

74LS00	14p
74LS02	14p
74LS03	14p
74LS04	16p
74LS05	20p
74LS08	20p
74LS09	20p
74LS10	20p
74LS11	25p
74LS12	30p
74LS13	30p
74LS14	50p
74LS20	20p
74LS21	25p
74LS22	27p
74LS26	30p
74LS27	30p
74LS30	20p
74LS32	27p
74LS33	27p
74LS37	30p
74LS38	30p
74LS40	25p
74LS42	60p
74LS47	60p
74LS51	24p
74LS55	30p
74LS73	40p
74LS74	27p
74LS75	36p
74LS76	45p
74LS83	70p
74LS85	80p
74LS86	40p
74LS90	40p
74LS92	70p
74LS93	50p
74LS96	110p
74LS107	45p
74LS109	60p
74LS112	40p
74LS113	90p
74LS114	45p
74LS122	80p
74LS123	60p
74LS124	180p
74LS125	45p
74LS126	45p
74LS132	60p
74LS133	45p
74LS136	40p
74LS138	55p
74LS139	55p
74LS145	120p
74LS147	160p
74LS148	140p
74LS151	70p
74LS153	60p
74LS154	200p
74LS155	60p
74LS156	60p
74LS157	50p
74LS158	60p
74LS160	75p
74LS161	75p
74LS162	75p
74LS163	60p
74LS164	75p
74LS165	100p
74LS166	120p
74LS173	110p
74LS174	80p
74LS175	75p
74LS181	200p
74LS190	75p
74LS191	75p
74LS192	75p
74LS193	75p
74LS194	90p
74LS195	90p
74LS196	90p
74LS197	90p
74LS221	90p
74LS240	120p
74LS241	120p
74LS242	90p
74LS243	90p
74LS244	100p
74LS245	120p
74LS247	140p
74LS251	75p
74LS253	75p
74LS257	75p
74LS258	75p
74LS259	100p
74LS266	50p
74LS273	120p
74LS279	75p
74LS283	75p
74LS298	100p
74LS299	375p
74LS323	250p
74LS324	150p
74LS348	200p
74LS365	48p
74LS367	50p
74LS368	50p
74LS373	120p
74LS374	120p
74LS375	60p
74LS377	100p
74LS378	80p
74LS390	90p
74LS393	90p
74LS399	120p
74LS445	140p
74LS540	250p
74LS541	300p
74LS640	300p
74LS641	300p
74LS642	300p
74LS643	300p
74LS644	300p
74LS668	100p
74LS670	225p

74S SERIES

74S00	60p
74S02	60p
74S04	60p
74S05	75p
74S08	75p
74S10	60p
74S20	60p
74S30	60p
74S32	90p
74S37	90p
74S64	60p
74S74	90p
74S85	300p
74S86	180p
74S112	120p
74S114	120p
74S124	300p
74S132	160p
74S133	75p
74S138	225p
74S139	225p
74S157	250p
745163	300p
74S174	250p
74S175	320p
74S194	350p
74S241	450p
74S260	70p
74S373	400p
74S374	400p

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8085A	550p
9980	2000p
Z80	400p
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R03-2513L.C	700p
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MC6847	1000p
SFF96364	800p

PERIPHERALS

3242	800p
3245	450p
6522	500p
6532	800p
6821	180p
6850	180p
6852	250p
6875	600p
8154	950p
8155	800p
8205	320p
8212	180p
8216	200p
8224	250p
8226	250p
8228	250p
8251	400p
8253	800p
8255	400p
8257	800p
8259	800p
8279	950p
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2107B	400p
2111 4L	300p
2112A	300p
2114 2L	200p
2114 4L	175p
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4044 4	600p
4118 4	550p
5101	300p
6116	£12
6810	200p
6514 45	400p
4164 20	£14

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74LS189	275p
74S201	450p
74S287	350p
74S387	350p
74S471	650p
74S472	300p
74S571	900p
74S573	900p
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1 x 77 WAY	630p	—
2 x 100 WAY	1000p	—

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Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

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This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

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The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

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LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

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Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

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BOOK PAGE

This month's diet of books is heavily flavoured with software publications.

The Alien, Numbereater and other Programs for Personal Computers
By John Race
86 pages £3.50
The Macmillan Press
ISBN 0 333 28079 2

There are a number of books available which contain program listings in BASIC, covering many varied topics. These range from the purely scientific through educational and simulation programs to a very wide selection of games. Some are very good, some are not so good; most work first time and some need a little attention before they can be coaxed to function on our own personal systems.

Dr Race's book contains 14 programs which will fit into 8K of memory, which are interesting, useful or unusual (perm any two from three!). They are well documented and we are told in the introduction that the book is for "...students, teachers or just enthusiasts... It is intended as a source of ideas for projects, a series of examples of techniques and other applications... The programs are written mostly in BASIC, and in particular Commodore PET BASIC... (but) should be transportable to other BASIC computers such as Apple, Tandy, Sorcerer... NASCOM, Acorn or Sinclair... There are also examples of Assembler and machine code programs for the MCS 6502 microprocessor used in the PET, Apple and many other systems."

The first program discussed is a palindrome tester. As a program you will use every day it is not exactly a WOW. It will only deal with a string 40 characters long and you could probably check for 'palindrometry' in the time it takes you to key in the letters. But, as an educational tool, it works in two ways:
1) the program illustrates the techniques of recursion and string handling
2) on RUNning the program it produces a clear graphical representation of what a palindrome is and how it is built up.

Most programs described list the principal techniques used or illustrated by that program, ie recursion, string handling, edge detection, Assembly programming, animation, error messages, etc.

Brackets, the second program, is again a teaching/educational exercise generating arithmetic expressions which are correctly 'formed' according to the rules stated for this exercise. RUNning the program produces a list of acceptable expressions. This may be useful to a lecturer — understanding what is happening and what techniques are being used is useful to everyone.

Orbit, the third program, is essentially a simulation game to establish a spacecraft in an orbit around the moon. It is well documented and explains the techniques and logic used to approach the solution. Altogether an entertaining and instructive exercise — a must for all would-be space pilots.

Superlife is yet another version of Conway's simulation. Just how many of them are there? This version fits into 8K and is again well documented, giving the option of machine code or BASIC routines for part of the program.

Other programs include 'Remover' which lives in the second cassette buffer and deletes REMs and spaces from a program. 'Clear' deletes unwanted program lines. 'Double density histograms' is a good example of the methods used to uprate the PET's graphics. The 'Alien' is an animated graphics fantasy and the 'Numbereater' is an addictive game for two players.

Altogether, this is a book that will both amuse and instruct. Several of the programs tax your understanding of what is to be achieved, which in turn will add to your knowledge of the computer and your programming ability.

Getting Acquainted with your ZX81 and New ROM ZX80 (2nd edition)
By Tim Hartnell
120 pages £4.95
Database Consultancy
ISBN 0 907563 01 5

Tim Hartnell has produced this book with the intention of giving the new user of the ZX81 a series of useful and worthwhile programs. With 75 programs between its covers, this book certainly lives up to his declared intentions. The programs vary from simple games needing little skill to quite complex 'machine intelligent' programs such as Draughts and Baker's Dozen. There are programs to plot curves, sort data and calculate interest on loans to fill up the gaps too.

The programs have been chosen (we are told) not only because they are valuable in their own right, but because they demonstrate specific functions of the ZX81. Any store of programs, providing they work and are not sloppily programmed, is valuable. They not only give you a source of pleasure, whether it be working out your finances or maths homework or playing games, but also provide you with a series of references for your own work.

This book fulfills this function and also gives you the basis of a 'hands-on' teaching program. It is not set out in a formal structure but it is easy to read, and providing you make the effort as you key in the programs you should eventually become a better programmer. The book has something for everyone. Headings include Serious Applications; demonstration plots, solving quadratic equations, standard deviation, etc as well as Games, Arrays, Random Numbers and Word Processor which is based on the special printer.

Brief instructions are given for fitting the 8K ROM to the ZX80 followed by a chapter on converting programs written for the '80 to the '81. The book concludes with the specifications of the '81 and the New ROM and the complete character set.

Throughout the book the documentation highlights the critical areas of the programs, giving the reader an added insight into the workings of his system. The practical approach used can only benefit the growing body of users.

---

50 Rip-roaring Games for the ZX80 and ZX81
Edited by Jeff Weinrich
85 pages £4.95
Database Consultancy
ISBN 0 907 563 00 7

This book contains 50 games programs. Of these, 37 will fit into 1K of memory, 3 fit into 2K and the rest need 4K. Right from the start we are told that there is no pretence of teaching BASIC programming and each program has just a short explanation on how to play it.

The games cover a pretty wide field, ranging from some fairly complex moving graphics games like 'Fools Breakout' through 'High Intelligence' (yours or the '80's?) board games to simpler programs like 'Siege'. Most are good fun, and some will provide a test for the grey matter.

The moving graphics games use a clever, and copyrighted, routine by Peter Vasey. It first appears on page 20 in the Ascot program. Although it appears elsewhere you are not simply referred back to page 20... so memorise it! A brief explanation at the end of the book will help those who want to convert '80 programs for use on the '81 and new ROM.

Those games I played worked first time, and if you enjoy games then this represents a useful addition to the library.

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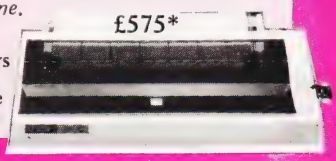

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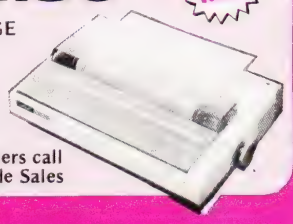

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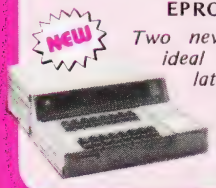

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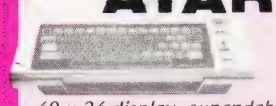

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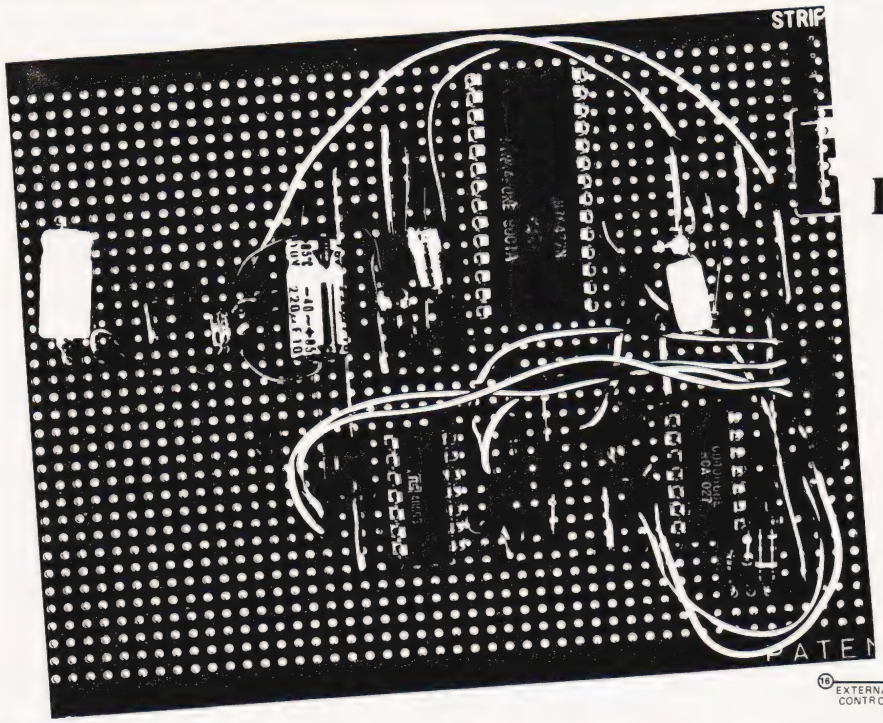

It may not be music but you can get some very interesting sounds out of FX-FACE

This simply constructed interface can produce over 7,000 different sounds. When you think of stringing a few of these together, each having a different duration, and so assembling a complex sound effect, you can see that the number of possible effects is virtually unlimited.

The interface is based on the cheapest of the sound effects ICs, the SN76477N. Some of its inputs can be digitally controlled but, usually, other parts of the system are programmed by hard-wiring them to resistors and capacitors of suitable value. The IC is intended to be used for a limited range of pre-programmed effects to be selected and turned on or off by digital control. In FX-FACE we control all the logical inputs directly from the microprocessor. In addition, the interface includes CMOS analogue switches for setting the values of programming resistors under the control of the microprocessor. The values of the switched resistors have been chosen to give a wide range of options. It is possible for the reader to modify these values to suit special applications.

The interface requires 16 data lines to control it. If you are using Acorn or Mk-14, you will need the INS8154 input/output (I/O) device. For the first time in this series we use all lines of both ports. The connections used are compatible with those you may already have made with other interfaces in this series.

The Effects Chip

To get the most out of FX-FACE it is important to know what is going on inside the IC. It has 28 pins, so we may rightly expect to find quite a number of subsystems within. Figure 1 shows the main ones. The chief sources of sound are the voltage controlled oscillator and the noise generator. The noise generator is a digital producer of pseudo-random white noise. This gives us the hissing, rushing and roaring noise so often required in sound effects. The VCO produces square waves of variable pitch in the audio frequency range. Its pitch is controlled either by a voltage applied from outside the IC or by a voltage from the super-low frequency oscillator (SLF). The SLF produces a saw-tooth waveform which is applied to the control input of the VCO to cause its pitch to rise and fall in siren fashion. The SLF also produces a square-wave which can be used as a sound effect in its own right.

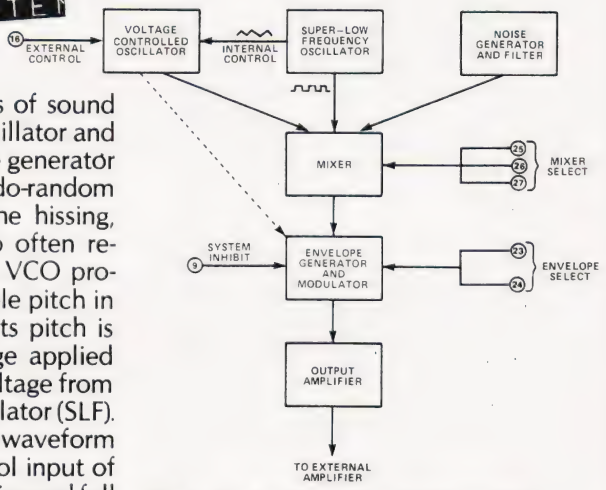

Fig.1. The main functional blocks within the effects chip.

The outputs of the noise generator, VCO and SLF all go to the mixer. There, any one of these, any pair, or all three can be passed on to the envelope generator and modulator. This part of the IC is concerned with the final shaping of the signal sent to the amplifier. The signal can, for example, be turned on and off by the system inhibit input. Once turned on it can be allowed to sound indefinitely or just once (one-shot) for a specified length of time. Some sounds start and stop abruptly, but others increase gradually in intensity as they begin and may fade away gradually as they end.

The envelope generator provides for a variable rate of attack and decay. It also allows the signal to be modulated, if required, in one of three ways: one-shot, by the output of the VCO and by alternate cycles of the VCO. The signal may also be passed unmodulated direct from mixer to amplifier.

If the input to pin 9 is high, sound output is zero. When taken low, the one-shot is triggered (if selected) and initiates the attack function. If taken high again, sound is immediately inhibited. It is possible to vary the length of a one-shot by a timing capacitor and resistor. There are not enough control lines to spare for this, so in FX-FACE the one-shot action is controlled digitally. It is triggered by taking the system inhibit input low, and terminated by taking pin 23 (one-shot capacitor pin, but no capacitor is required for this) high. Timing of the one-shot is thus under the control of the program. The decay action is triggered automatically by the ending of the one-shot or VCO enevelope. It does not operate on un-modulated (mixer only) signals.

The output from the modulator is passed to an output amplifier. In FX-FACE its output then goes to a push-pull transistor amplifier. The volume of sound from the loudspeaker is enough (some might say more than enough!) for most applications.

Implementation

In designing this circuit the aim has been to cater for as wide a range of requirement as possible within the limits of using 16 direct control lines, and of not relying on coding commands, with registers to hold them, and all the programming and circuit complexity that this entails. In the description which follows we see how the IC is used in FX-FACE, taking each subsystem in turn.

SLF oscillator: The frequency of this is determined by a capacitor connected to pin 21 and a resistor connected to pin 20. To allow the frequency to be controlled by the microprocessor a CMOS analogue switch (4066) is used to switch resistors R2 and R3 in parallel with R1 (Fig.2). To obtain the required range, two capacitors are wired in parallel to give a total capacitance of 3u2. For the benefit of those unfamiliar with analogue switches, it should be explained that the 4066 contain four independent switches. Each has two terminals and a control input. When the input is low (0 V) the resistance between switch terminals is exceedingly high (10^{13} R). When the control input is high (+5 V in this circuit), resistance falls to a low value. At 5 V the switch resistance is about 270R, which is negligible. With the two switches open (input 00), SLF operates at its lowest frequency, 0.2 Hz. With input 01, frequency is 6 Hz. Inputs 10 and 11 give 20 Hz and 30 Hz respectively. The reference to A0, A1 etc on the figures refer to the output ports of the I/O device which control the switches.

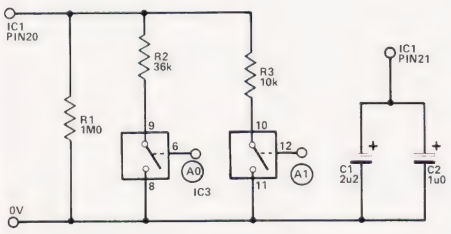

Fig.2. Controlling the frequency of the SLF oscillator.

VCO: This is controlled by two circuits, both analogue-switched (Fig.3). Ports A2 and A3 control frequency by switching resistors R5 and R6 in or out of the potential-divider network consisting of R4-R6. This gives four different voltages between 0 V and 2V5 which are applied to pin 16 to control frequency. The frequencies obtained also depend on the circuit controlled by A4. This sets the *minimum* VCO frequency, by switching 10k or 112k between pin 18 and the 0 V line.

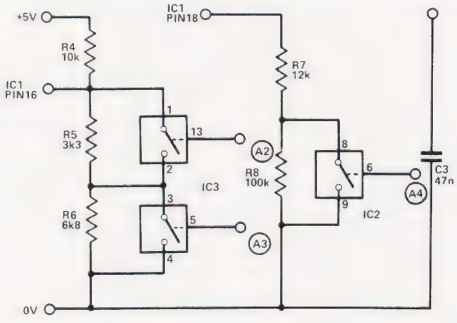

Fig.3. Analogue switch controls for the VCO.

Frequencies obtained are:

A2 A3	A4 = 1	A4 = 0
00	1220 Hz	145 Hz
01	1430 Hz	167 Hz
10	2080 Hz	250 Hz
11	6250 Hz	770 Hz

These eight frequencies are obtained only when the VCO is put under external control, by making the VCO control input (pin 22) low. Otherwise the VCO is under the control of the SLF.

Attack and decay: Figure 4 shows how these are varied by switched resistors. With A5 high, R12 is switched out and C5 charges rapidly, giving fast attack. The decay function shares the same capacitor, which is discharged through R13 and (possibly) R14. These functions are to a certain extent linked; for example, with a sound of short duration, *fast* attack charges C5 rapidly to a high level. *Slow* decay then takes much longer to discharge C5 to a low level. If attack is *slow,* C5 does not become fully charged before discharge begins, so the sound dies away more rapidly.

Noise rolloff: The output of the noise generator goes to a filter, controlled by the circuit of Fig. 5. With A7 low the filter attenuates frequencies greater than 10 kHz. This gives a sound similar to that of water rushing over a waterfall. With A7 high, frequencies up to 100 kHz are passed and the output

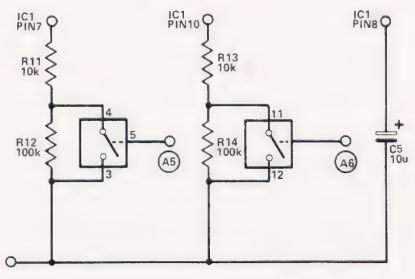

Fig.4. Switched resistors control the attack and decay.

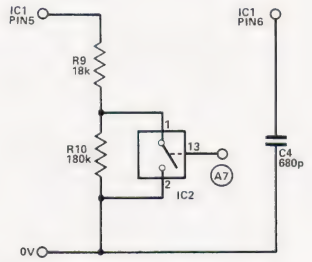

Fig.5. Filtering the noise output to create rolloff.

sounds like steam escaping under pressure.

All the functions listed above are controlled from Port A. Those which follow are controlled from Port B. All outputs from Port B go direct to the IC.

System: This is a direct logic input which enables or inhibits sound output. It also triggers one-shot, as explained above.

VCO control: This selects internal or external control of the VCO.

One-shot: It enables or terminates the one-shot function.

Mixer select: This selects one or any combination of SLF, VCO and noise. The 3-bit selection code is shown on the FX-FACE coding chart.

Envelope select: If 'mixer' is selected there is no envelope to the output, except for the attack ramp. Otherwise the envelopes are as shown in Fig.6.

Other connections: Pin 2, 0 V line; pin 3, external noise clock (not used, so grounded); pin 4, noise clock resistor (R15); pin 11, amplifier amplitude control resistor (R16); pin 14, for unregulated supply (not used); pin 15, +5 V regulated supply; pin 19, pitch control fixed at +5 V.

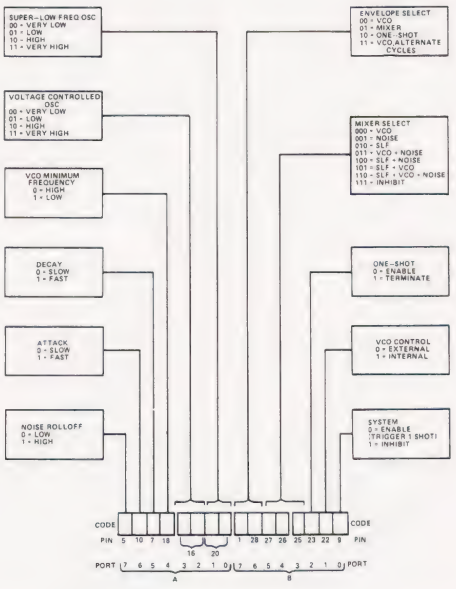

Fig.6. The control functions performed by the two ports.

Construction

The circuit board (Fig. 7) accommodates the ICs, and the amplifier circuit (Fig. 8). It is advisable to use sockets so that faults may be traced more easily should they occur.

There are no special problems of assembly. The board is connected to the micro system by PCB plugs and sockets of the type previously used in this series. Connections to Acorn and Mk-14 are shown in Figs. 9 and 10. The wiring to the sockets follows the pattern used before. One socket carries the 0 V and +5 V rails, plus ports B0 to B2. Another socket carries B3 to B7. We can now add connections to the socket used for A0 (for THERMOFACE, CT July 1980) so that it carries the lines from A0 to A4. A 3-way socket carries lines A5 to A7.

Testing

When the circuit is assembled, check all connections carefully and look for threads of solder bridging the tracks. Also examine each place where the strips are to be cut and check that they really are severed completely across. Then push the sockets on to the plugs and switch on the system. A whistling sound, possibly mixed with other sounds, should be heard. If not, suspect power supply failure or a misconnection somewhere in the system.

To test the system load a program such as one of those given for Acorn or Mk-14. The programs first define all ports as outputs. The command codes are stored in tables. Table 1 (0020-002F in Acorn, 0F60-0F6F in Mk-14) contains the codes for Port A. Up to 16 codes can be listed to produce 16 different sounds in sequence, then repeat the sequence. Table 2 (0030-003F, or 0F70-0F7F) contains codes for Port B. Table 3 (0040-004F, or 0F80-0F8F) contains variables for the duration of each sound. In the Acorn program the maximum duration is given by setting registers to 80H. In the Mk-14 the variable determines how many times the delay loop is run. With FFH as the delay factor and 01H in the register the duration is about 0.26 S. The register can hold values up to FFH, which gives a duration of about one minute. The other variable to be stored is

Parts List

Resistors (All ¼W, 5%)

R1	1M
R2	36k
R3,4,11,13	10k
R5	3k3
R6	6k8
R7	12k
R8,12,14	100k
R9	18k
R10	180k
R15,17	47k
R16	150k
R18	3k9

Capacitors

C1	2u2 tantalum
C2	1u tantalum
C3	47n polyester
C4	680p polystyrene
C5	10u tantalum
C6	220u electrolytic
C7	100u electrolytic

Semiconductors

Q1	ZTX 300
Q2	ZTX 500
IC1	SN76477N
IC2,3	4066 Quad analogue switch

Miscellaneous

LS1	8R miniature loudspeaker

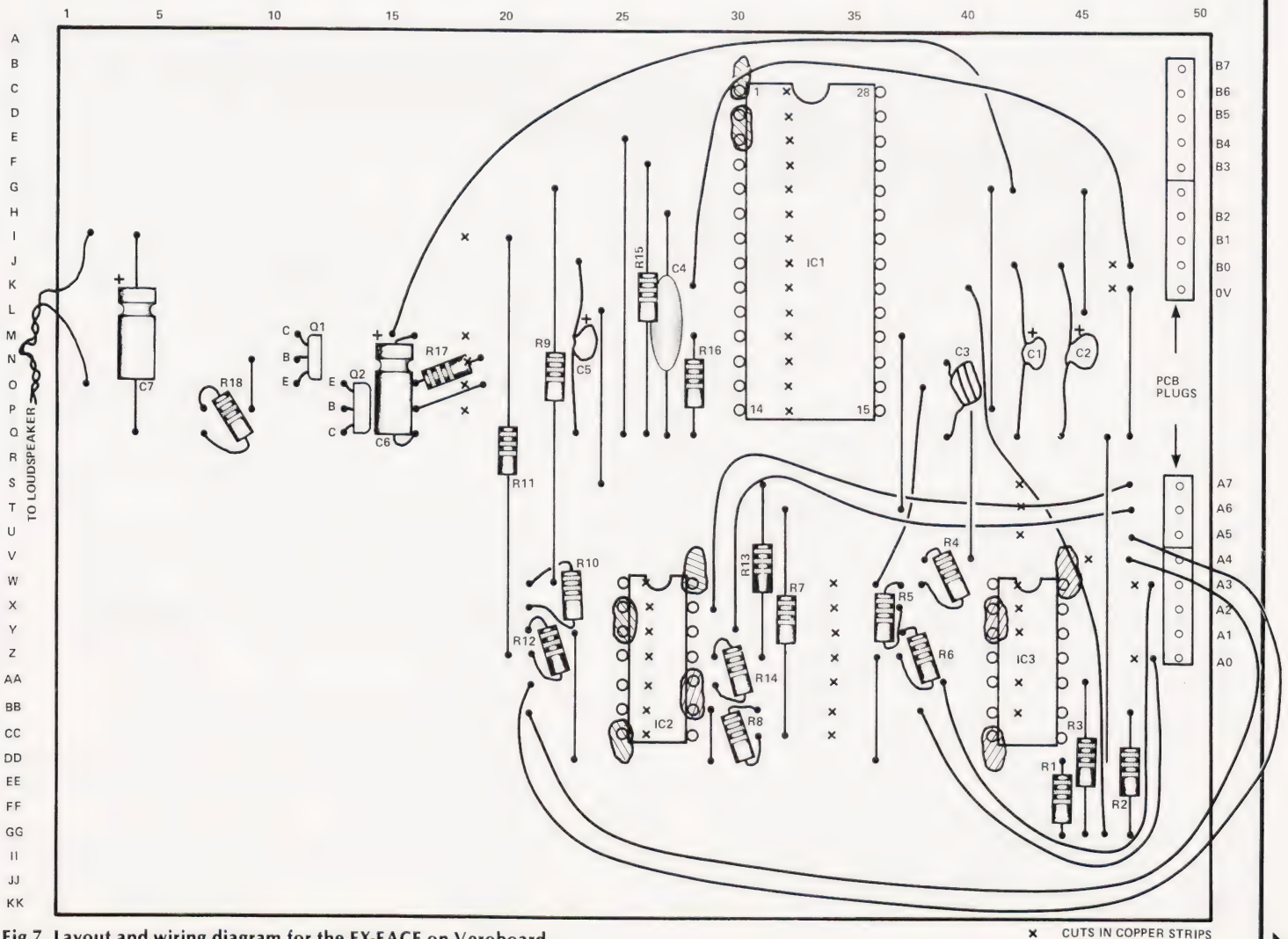

Fig.7. Layout and wiring diagram for the FX-FACE on Veroboard.

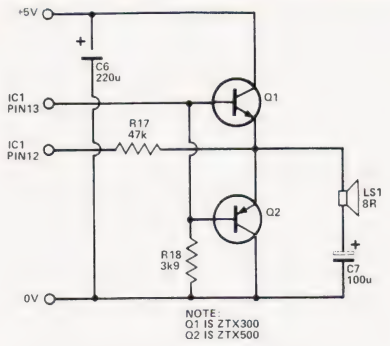

Fig.8. A suitable amplifier circuit.

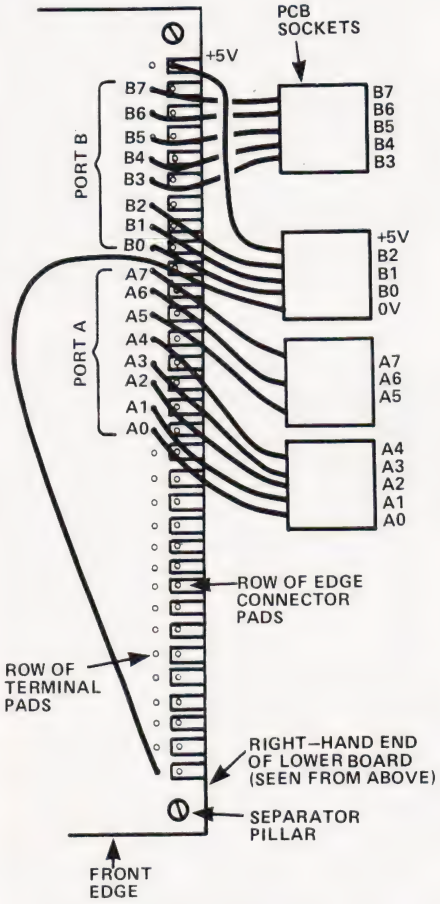

Fig.9. The wiring connections for the Acorn.

Fig.10. As Fig.9. But for the Mk-14.

N, the number of sounds to make up a sequence. This is stored at 0050 in Acorn or at 0F1F in Mk-14. The maximum value here is 10H.

Checking Out

Before beginning this it is good fun just to press GO and see what happens with random numbers in the registers. You should get all manner of squeaks, crashes, squawks, chirrups and wails. If some of these take your fancy, run through the tables to see which codes produced them.

Having done that, it is still a good idea to check through the system, both to ensure that all sections of the system are working properly and to familiarise yourself with the effects produced by the various commands. In the test listed below "A=" gives the codes for Table 1, in order, and "B=" gives the codes for Table 2. All registers in Table 3 should be set to 80H for Acorn, or 02H for the Mk-14. "N=" is the number of sounds in the cycle (0050 or 0F1F).

Noise rolloff: A=E0, 60. B=48, 48. N=02. Turns rolloff on and off alternately; sounds like a puffing steam locomotive.

Attack and decay: A=04,04. B=80,81. N=2. The second value of B inhibits sound, ready to trigger attack on the repeat sequence. The code gives slow attack and decay. Repeat with A=24,24; A=44,44; and A=64,64 to get slow attack / fast decay, fast attack / slow decay, and fast attack / fast decay, respectively.

VCO minimum frequency: A=64,64. B=40,40. N=02. A two-tone note (1430 Hz and 167 Hz, approx).

VCO: A=70,74,78,7C. B=40,40,40, 40. N=04. A series of four notes, rising in pitch. You can also try this with A=60,64,68,6C, for lower minimum frequency.

SLF: A=60,61,62,63. B=50,50,50, 50. N=04. A sequence of very low buzzes, just below the audio range. The first one is so low that no sound is heard except a 'tick' once every 2.5 S. Use a voltmeter to monitor the SLF at pin 21.

Envelope select: This test applies the envelope to the output of the noise generator. A=70. B=08. N=01. This test and demonstrates the VCO envelope. Change B to C8 to test the alternate VCO envelope. Changing B to 48 gives mixer only (no envelope). Finally try A=70,70. B=89,88. N=02. This tests the one-shot. There should be repeated bursts of noise.

Mixer select: A=7B. B=40, 40, 48, 48, 50, 50, 58, 58, 60, 60, 68, 68, 70, 70, 78, 78. N=10. This runs through all selections. Use the coding chart to work out which is which.

One-shot: A=74, whole table. B=81, followed by all 80s. N=10. The 81 triggers the one-shot. It is terminated by putting 84 in Table 2. Put it in different positions (except the first) and obtain one-shots of different lengths. Termination is always followed by decay, if any.

VCO control: A=77,77. B=40,42. N=02. Alternate steady note and siren-like note.

System: A=76,76. B=42,43. N=02. A series of 'pips' with silence between.

Application

By now you should be ready to program your own sounds. The programs given here are useful for this and form

PROGRAM A: Sound sequence, for 6502, in Acorn

```
0200  A9 FF      LDAX 'FF'          Define ports
0202  8D 22 09   STA at ODA         as outputs
0205  8D 23 09   STA at ODB
0208  A2 00    A: LDX X00           Set pointer to zero
020A  B5 20    B: LDA ZX,20         Get A code
020C  8D 20 09   STA at Port A
020F  B5 30      LDA ZX,30          Get B code
0211  8D 21 09   STA at Port B
0214  B5 40      LDA ZX,40          Get C code
0216  A8         TAY                Time (C) code to Y
0217  20 CD FE C: JSR to WAIT subroutine
021A  88         DEY                Decrement loop counter
021B  10 FA      BPL to C if time not up
021D  E8         INX                Increment pointer
021E  E4 50      CPX ZX,50          Compare with N code
0220  F0 E6      BEQ to A,          If sequence finished
0222  4C 0A 02   JMP to B           for next sound
0224             =END
```

the basis of a subroutine that can be appended to games programs and the like. Use the Coding Chart to help you work out the codes. Place a piece of paper over the 'Code' blanks. Work up the left-hand side of the chart and then down the right-hand side, filling in the 0s or 1s. Then convert the 16-bit number into four hexadecimal digits.

A Few To Try

To get you started, here are a few effects that illustrate the range obtainable. In each example make N equal to the number of codes in each table. Make C = 80H in Acorn or 02H in Mk-14.

Twittering bird: A = 56. B = 42.
Spacecraft engines: A = 45. B = 42.
Siren: A = 00. B = 42.
Motor cycle engine: A = 82. B = 70.
Rapid high-pitched 'pips': A = DD. B = 68.
Jungle sounds, birds and crickets: A = 56,55. B = 42,42.
Steam locomotive at high speed: A = DD. B = 26. (To get the effect of it chuffing along more slowly, add a second sound (A = 5D. B = 26) and make this half as long as the first.)
Curious sound often associated with persons being vaporised or, conversely, materialising in SF films: A = D5. B = 42.
Space war: A = 45,45,00,00. B = 42, 42, 70 42. The second and fourth sounds are to be one quarter of the duration of the first and third.

PROGRAM B: Sound sequence, for SC/MP, in Mk-14.

```
0F1E                    = counter for delay loops
0F1F                    = no. of sounds
0F20  C4  08            LDI '08'
0F22  35                XPAH P1          P1 to I/O (0800)
0F23  C4  00            LDI '00'
0F25  31                XPAL P1
0F26  C4  FF            LDI 'FF'         Define all ports
0F28  C9  22            ST at Port A     as outputs
0F2A  C9  23            ST at Port B
0F2C  C4  0F        A:  LDI 'OF'
0F2E  36                XPAH P2          P2 to tables (0F60)
0F2F  C4  60            LDI '60'
0F31  32                XPAL P2
0F32  C2  00        B:  LD P2+00         Get A code
0F34  C9  20            ST at Port A
0F36  C2  10            LD P2+10         Get B code
0F38  C9  21            ST at Port B
0F3A  C2  20            LD P2+20         Get C code (time)
0F3C  C8  E1            ST at 0F1E
0F3E  C6  01            LD @ +01         Increment P2
0F40  8F  FF        C:  DLY
0F42  B8  DB            DLD              Counting delay loops
0F44  9C  FA            JNZ to C         For next loop
0F46  B8  D8            DLD              Counting sounds
0F48  9C  E8            JNZ to B         For next sound
0F4A  90  E0            JMP to A         For next sequence
0F4B                    = END
```

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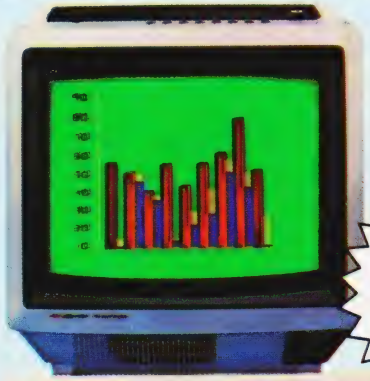

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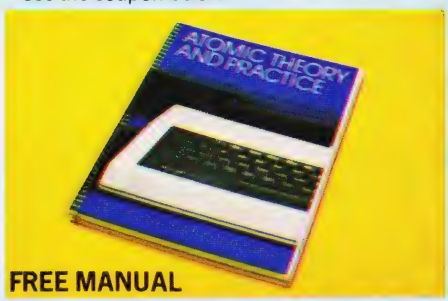

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We are pleased to be able to announce the commencement of a new series of Adventure games. The series named "Mysterious Adventures" is written in machine language by B. Howarth, an English author. The first episode is entitled "The Golden Baton". The scenario is that you have been sent by the ruler of your own land to a strange province with the mission of discovering the whereabouts of the legendary Golden Baton of Ferrenuil, King of the Ancient Elf Kingdom. The baton mysteriously disappeared several years ago and whilst others have ventured to the land in an attempt to discover it, none have returned to tell their tale!

The program follows what has become the normal structure for Adventure programs. Like the original main frame Adventure, directions can be designated by just the first letter of the compass point and commands may be optionally entered with just the first three letters of the appropriate word. As usual provision is made for saving the game at any stage and such standard commands as Help, Inventory, Score and Quit are all available. Experienced adventurers will inevitably draw comparisons between this series and that of Scott Adams, so we will leave it to them to make their judgements! The only comment that we will make at this time is that we find it quite invigorating to play an Adventure game by a different author as obviously they construct their stories slightly differently. Mysterious Adventure 1, "The Golden Baton" is available on cassette for TRS-80 or Video Genie machines of 16K or more and on disk for 32K up machines. It occupies a full 16K. The tape versions save their game to tape and the disk to disk.

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6502 PROGRAMMING COURSE

A P Stephenson

The final part of our series presents a simple Assembler,written in BASIC it should be suitable for most 6502 systems.

An Assembler is a major item in the field of software support and consequently entails many hours of programming effort, perhaps even measured in man-years! The primary function of a good assembler is to ease the burden of programming in machine language and a full-blooded version would include the following facilities:

1. The use of mnemonic operators (letter groups) instead of inhuman pairs of hexadecimal digits.
2. The use of variable names in the operand column instead of machine addresses in Hex, providing the chosen name is declared initially.
3. A choice of decimal or hexadecimal in all numeric work.
4. Extensive editing, correcting and debugging operations.

The Program

The MicroAssembler listing shown is unpretentious and offers few of the above facilities. It does, however, allow the use of mnemonic operators instead of Hex code. The operand addresses can be entered in decimal instead of the error-prone Hex digits written in reverse byte order. The 6502's insistance on lower order byte first may be efficient for the chip electronics but it is unkind to poor humans.

You will still have to count the bytes in branch instructions but at least you can count in decimal. For branching back, the procedure is to *subtract* the number from 256 which is in reality another method of finding the 'ten's complement'...subtract each digit from the radix-1. Example: To branch back 3 bytes, the correct operand is 256-3 = 253.

Program Options

There are four options, the first being some instructions in the use of the assembler. You will note that all programs must begin with the psuedo op-code START followed by the decimal starting address. For PET this will normally be 832 which is the decimal equivalent of 0340 Hex (the infamous second cassette buffer on the PET). The program must always finish with the pseudo-code END because it is the signal to the assembler to return to the option page. When this happens, your program should be correctly translated into machine code and resident in the memory at the START address. If you make a mistake, the only help you will get from the assembler is a '?' if, for example, you enter an illegal mnemonic. One space after the op-code is mandatory.

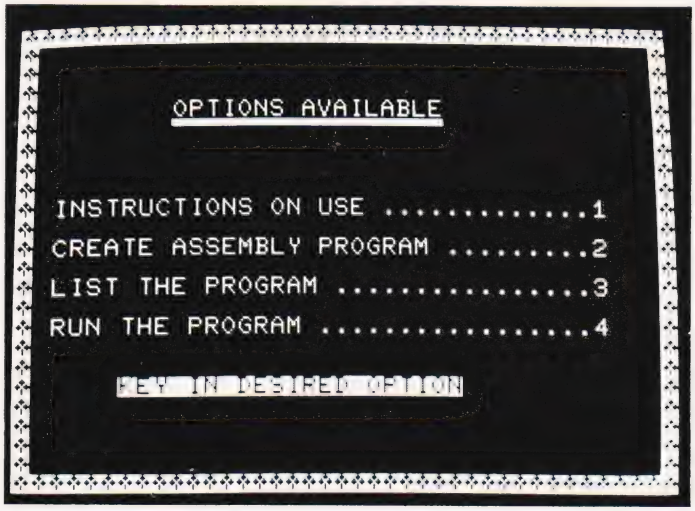
The third option enables you to LIST the program. The presentation includes the decimal and hexadecimal addresses of each instruction, the machine code and the assembly code. Apart from looking at your own program, the mysteries of the ROM operating system are revealed including the BASIC interpreter. You may notice that in this area, there are many addresses unused and consequently are signalled by the assembler 'GARBAGE CODE'.

As a matter of interest, you may also find hundreds of 'AA's — or similar codes in the area of user RAM. This is because of the initial power-on sequence in which all memory locations are tested...a standard test pattern (known as checker-board) is binary 10101010 which is AA in Hex.

The fourth option is RUN the program, which begins by asking for the decimal START address. Sometimes the result ends with the operating systems message 'Illegal quantity error', but ignore this. In most cases your machine code program will be a short subroutine, entered from BASIC with SYS and this screen pollution will be absent. The microassembler is written in BASIC. Machine code would have taken me too long...at least, that's my story and I'm sticking to it!

The method of translating the machine code into mnemonic letter groups is straightforward practice. The codes are laid out between lines 2010 to 2580 *in the order of the machine code.* Thus the first code is BRK which has the Hex code 00, the next is ORAIX which has the code 01, the next is a non-existent code 02 so the mnemonic is arbitrarily called NOGO. The figure next to each code is the *number of bytes* in the instruction.

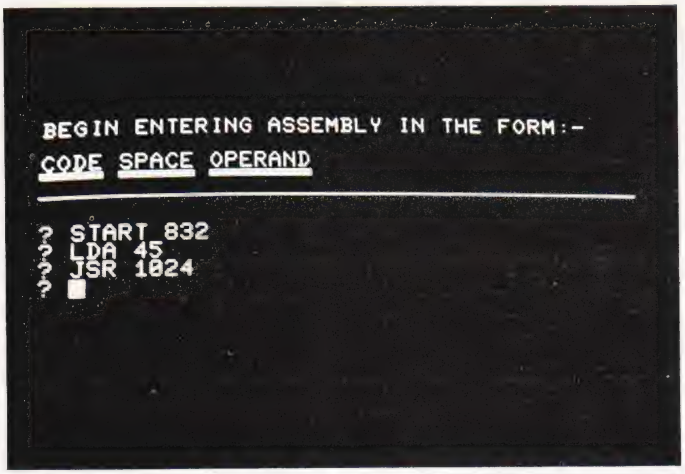
These groups are READ sequentially, into the arrays C$(E) for the letter groups and U%(E) for the number of bytes figure, at lines 170 to 190. Thus there is a one-to-one relationship between mnemonic letter groups and the subscript E.



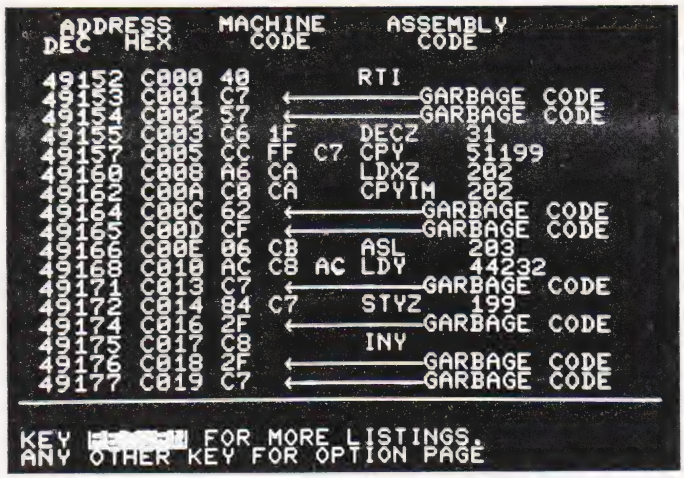
Program Listing

```
100 REM**MICROASSEMBLER
110 G=16:G1=256:G2=4096:ER$="BAD DATA"
120 PRINT CHR$(147)
130 DIM C$(G1),U%(G1),L$(G)
140 GOSUB 1910
150 PRINT TAB(250)"WAIT A FEW SECONDS"
160 REM**READ OP CODES
170 FOR E=0 TO G1-1
180 READ C$(E),U%(E)
190 NEXT E
200 REM**READ HEX CODE
210 FOR E=0 TO G-1
220 READ L$(E)
230 NEXT E
240 PRINT CHR$(147):PRINT:PRINT:PRINT
250 PRINT"[9 SPC]OPTIONS AVAILABLE
```

```
260 PRINT"[9 SPC][17©#]":PRINT:PRINT:PRINT
270 PRINT"[2 SPC]INSTRUCTIONS ON USE ......1":PRINT
280 PRINT"[2 SPC]CREATE ASSEMBLY PROGRAM ..2":PRINT
290 PRINT"[2 SPC]LIST THE PROGRAM .........3":PRINT
300 PRINT"[2 SPC]RUN THE PROGRAM ..........4":PRINT
    :PRINT
310 PRINT"[7 SPC][REV]KEY IN DESIRED OPTION[OFF]"
320 GOSUB 1910:REM**BORDER
330 POKE 158,0
340 GET K$:IF K$="" THEN 340
350 IF VAL(K$)=0 OR VAL(K$)>4 THEN 340
360 ON VAL(K$) GOSUB 390,1310,660,1140
370 IF VAL(K$)=4 THEN STOP
380 GOTO 240
390 PRINT CHR$(147):PRINT
400 PRINT"[3 SPC]INSTRUCTIONS ON USE OF ASSEMBLER
410 PRINT"[3 SPC][32©#]":PRINT
420 PRINT"[2 SPC]ALL OPERANDS MUST BE IN DECIMAL."
430 PRINT
440 PRINT"[2 SPC]WHEN BRANCHING BACK N BYTES,USE":PRINT
450 PRINT"[2 SPC]256-N TO CALCULATE OPERAND."
460 PRINT
470 PRINT"[2 SPC]COMMENCE ALL PROGRAMS WITH [REV]
    START[OFF]"
480 PRINT
490 PRINT"[2 SPC]FOLLOWED BY START ADDRESS."
500 PRINT
510 PRINT"[2 SPC]FINISH ALL PROGRAMS WITH[REV]END[OFF]"
520 PRINT
530 PRINT"[SPC][38©$]":PRINT:PRINT
540 PRINT"[10 SPC][REV]PRESS ANY KEY[OFF]"
550 GOSUB 1910
560 POKE 159,0
570 GET K$:IF K$="" THEN 570
580 GOTO 240
590 SX=INT(DC/G)
600 UN=DC-(SX*G)
610 SX$=L$(SX)
620 UN$=L$(UN)
630 HX$=SX$+UN$
640 RETURN
650 REM**LIST PROGRAM
660 PRINT CHR$(147)
670 INPUT"START ADDRESS";AD:I=0
680 PRINT CHR$(147)
690 PRINT"[SPC][©O][7©#][©P][SPC][©O][7©#][©P][SPC][©O]
    [10©#][©P]"
700 PRINT"[2 SPC]ADDRESS[3 SPC]MACHINE[4 SPC]ASSEMBLY"
710 PRINT"[SPC]DEC[2 SPC]HEX[5 SPC]CODE[7 SPC]CODE"
    :PRINT
720 IF I=17 THEN 1040
730 I=I+1
740 IB=PEEK(AD)
750 IF C$(IB)<>"NOGO" THEN 790
```



The false mnemonic START tells the assembler where to begin.



Listing out a section of the computer's own memory can reveal the BASIC or operating system.

```
760 DC=IB:GOSUB 590:GOSUB 1180
770 PRINT AD;AD$ TAB(12);HX$;"[2 SPC][8©C]GARBAGE CODE"
780 AD=AD+1:GOTO 720
790 ON U%(IB) GOTO 800,840,920
800 DC=IB:GOSUB 590:GOSUB 1180
810 PRINT AD;AD$ TAB(12);HX$;TAB(21);C$(IB)
820 AD=AD+1
830 GOTO 1030
840 DC=IB:GOSUB 590
850 B1$=HX$
860 DC=PEEK(AD+1):GOSUB 590
870 B2$=HX$
880 GOSUB 1180:P=DC
    C$(IB);TAB(27);P
890 PRINT AD;AD$;TAB(12);B1$;"[SPC]";B2$;TAB(21);
900 AD=AD+2
910 GOTO 1030
920 DC=IB:GOSUB 590
930 B1$=HX$
940 DC=PEEK(AD+1):GOSUB 590
950 B2$=HX$
960 DC=PEEK(AD+2):GOSUB 590
970 B3$=HX$
980 OP=PEEK(AD+1)+PEEK(AD+2)*256
990 GOSUB 1180
1000 PRINTAD;AD$;TAB(12);B1$;"[SPC]";B2$;"[SPC]";
1010 PRINT B3$;TAB(21);C$(IB);TAB(27);OP
1020 AD=AD+3
1030 GOTO 720
1040 PRINT"[40©C]"
1050 PRINT"KEY [REV]RETURN[OFF] FOR MORE LISTINGS."
1060 PRINT"ANY OTHER KEY FOR OPTION PAGE"
1070 POKE 158,0
1080 GET A$:IF A$="" THEN 1080
1090 IF A$=CHR$(19) THEN I=0:RETURN
1100 IF A$<>CHR$(13) THEN 240
1110 I=0:PRINT CHR$(147)
1120 GOTO 720
1130 REM**RUN PROGRAM
1140 PRINT CHR$(147)
1150 INPUT"ENTER ADDRESS IN DECIMAL";AD
1160 SYS(AD)
1170 RETURN
1180 A=AD:S3=INT(AD/G2)
1190 A=A-S3*G2
1200 S2=INT(A/G1)
1210 A=A-S2*G1
1220 S=INT(A/G)
1230 U=AD-(S3*G2+S2*G1+S*G)
1240 S3$=L$(S3)
1250 S2$=L$(S2)
1260 S$=L$(S)
1270 U$=L$(U)
1280 AD$=S3$+S2$+S$+U$
```

```
1290 RETURN
1300 REM**CREATE ASSEMBLY PROGRAM
1310 PRINT CHR$(147)
1320 PRINT"BEGIN ENTERING ASSEMBLY IN THE FORM:-":PRINT
1330 PRINT"CODE SPACE OPERAND"
1340 PRINT"[18©#]"
1350 PRINT"[40©C]"
1360 GOSUB 1710
1370 F=0
1380 FOR E=0 TO 255
1390 IFC$=C$(E) THEN BY=U%(E):F=1:CD=E:E=256
1400 NEXT E
1410 IF F=0 GOTO 1600
1420 ON BY GOSUB 1440,1470,1520
1430 GOTO 1360
1440 POKE AD,CD
1450 AD=AD+1
1460 RETURN
1470 IF OP>255 OR OP<0 THEN PRINT ER$:RETURN
1480 POKE AD,CD
1490 POKE AD+1,OP
1500 AD=AD+2
1510 RETURN
1520 IF AD>65535 OR OP<0 THEN PRINT ER$:RETURN
1530 POKE AD,CD
1540 B2=INT(OP/G1)
1550 B1=OP-(B2*G1)
1560 POKE AD+1,B1
1570 POKE AD+2,B2
1580 AD=AD+3
1590 RETURN
1600 IF C$="START" OR C$="END" THEN 1620
1610 PRINT ER$:GOTO 1360
1620 IF C$="START" THEN 1640
1630 GOTO 1680
1640 IF FO=1 THEN PRINT ER$:GOTO 1360
1650 FO=1
1660 AD=OP:Q1=OP
1670 GOTO 1360
1680 IF C$="END" THEN 1690
1690 EN=AD-1
1700 RETURN
1710 INPUT A$
1720 IF LEN(A$)<3 THEN PRINT ER$:GOTO 1710
1730 IF LEN(A$)=3 THEN C$=A$:OP=0:RETURN
1740 S=0:FOR M=1 TO LEN(A$)
1750 IF MID$(A$,M,1)="[SPC]" THEN S=M:M=LEN(A$)
1760 NEXT M
1770 IF S=0 THEN MN$=A$:RETURN
1780 C$=LEFT$(A$,S-1)
1790 OP=VAL(RIGHT$(A$,LEN(A$)-S))
1800 RETURN
1810 POKE 59411,53
1820 T=TI
1830 IF (TI-T)<6 THEN 1830
1840 POKE 59411,61
1850 SZ=SZ-191
1860 RETURN
1870 REM**KICKOUT
1880 PRINT CHR$(147)
1890 A=USR(0)
1900 PRINT"OK"
1910 REM**PRINT BORDER
1920 A8=32768:B8=40
1930 FOR C8=0 TO 39
1940 POKE A8+C8,216:POKE A8+C8+B8*23,216
1950 NEXT C8
1960 FOR C8=1 TO 23
1970 POKE A8+B8*C8,216:POKE A8+B8*C8+39,216
1980 NEXT C8
1990 RETURN
2000 REM**OP CODE,NUMBER OF BYTES
2010 DATA BRK,1,ORAIX,2,NOGO,0,NOGO,0
2020 DATA NOGO,0,ORAZ,2,ASL,2,NOGO,0,PHP,1
2030 DATA ORAIM,2,ASLA,1,NOGO,0,NOGO,0
2040 DATA ORA,3,ASL,3,NOGO,0,BPL,2,ORAIY,2
2050 DATA NOGO,0,NOGO,0,NOGO,0,ORAZX,2
2060 DATA ASLZX,2,NOGO,0,CLC,1,ORAY,
2070 DATA NOGO,0,NOGO,0,NOGO,0,ORAX,3
2080 DATA ASLX,3,NOGO,0,JSR,3,ANDIX,2,NOGO,0
2090 DATA NOGO,0,BITZ,2,ANDZ,2,ROLZ,2
2100 DATA NOGO,0,PLP,1,ANDIM,2,ROLA,1,NOGO,0
2110 DATA BIT,3,AND,3,ROL,3,NOGO,0,BMI,2
2120 DATA ANDIY,2,NOGO,0,NOGO,0,NOGO,0
2130 DATA ANDZX,2,ROLZX,2,NOGO,0,SEC,1
2140 DATA ANDY,3,NOGO,0,NOGO,0,NOGO,0,ANDX,3
2150 DATA ROLX,3,NOGO,0,RTI,1,EORIX,2
2160 DATA NOGO,0,NOGO,0,NOGO,0,EORZ,2,LSRZ,2
2170 DATA NOGO,0,PHA,1,EORIM,2,LSRA,1
2180 DATA NOGO,0,JMP,3,EOR,3,LSR,3,NOGO,0
2190 DATA BVC,2,EORIY,2,NOGO,0,NOGO,0
2200 DATA NOGO,0,EORZX,2,LSRZX,2,NOGO,0
2210 DATA CLI,1,EORY,3,NOGO,0,NOGO,0
2220 DATA NOGO,0,EORX,3,LSRX,3,NOGO,0,RTS,1
2230 DATA ADCIX,2,NOGO,0,NOGO,0,NOGO,0
2240 DATA ADCX,2,RORZ,2,NOGO,0,PLA,1,ADCIM,2
2250 DATA RORA,1,NOGO,0,JMPIM,3,ADC,3
2260 DATA ROR,3,NOGO,0,BVS,2,ADCIY,2,NOGO,0
2270 DATA NOGO,0,NOGO,0,ADCZX,2,RORZX,2
2280 DATA NOGO,0,SEI,1,ADCY,3,NOGO,0,NOGO,0
2290 DATA NOGO,0,ADCX,3,RORX,3,NOGO,0
2300 DATA NOGO,0,STAIX,2,NOGO,0,NOGO,0,STYZ,2
2310 DATA STAZ,2,STXZ,2,NOGO,0,DEY,1
2320 DATA NOGO,0,TXA,1,NOGO,0,STY,3,STA,3
2330 DATA STX,3,NOGO,0,BCC,2,STAIY,2
2340 DATA NOGO,0,NOGO,0,STYZX,2,STAZX,2,STXZY,2
2350 DATA NOGO,0,TYA,1,STAY,3,TXS,1
2360 DATA NOGO,0,NOGO,0,STAX,3,NOGO,0,NOGO,0
2370 DATA LDYIM,2,LDAIX,2,LDXIM,2,NOGO,0
2380 DATA LDYZ,2,LDAZ,2,LDXZ,2,NOGO,0
2390 DATA TAY,1,LDAIM,2,TAX,1,NOGO,0
2400 DATA LDY,3,LDA,3,LDX,3,NOGO,0,BCS,2
2410 DATA LDAIY,2,NOGO,0,NOGO,0,LDYZX,2
2420 DATA LDAZX,2,LDXZY,2,NOGO,0,CLV,1
2430 DATA LDAY,3,TSX,1,NOGO,0,LDYX,3
2440 DATA LDAX,3,LDXY,3,NOGO,0,CPYIM,2,CMPIX,2
2450 DATA NOGO,0,NOGO,0,CPYX,2,CMPZ,2
2460 DATA DECZ,2,NOGO,0,INY,1,CMPIM,2,DEX,1
2470 DATA NOGO,0,CPY,3,CMP,3,DEC,3,NOGO,0
2480 DATA BNE,2,CMPIY,2,NOGO,0,NOGO,0
2490 DATA NOGO,0,CMPZX,2,DECZX,2,NOGO,0
2500 DATA CLD,1,CMPY,3,NOGO,0,NOGO,0,NOGO,0
2510 DATA CMPX,3,DECX,3,NOGO,0,CPXIM,2
2520 DATA SBCIX,2,NOGO,0,NOGO,0,CPXZ,2,SPCZ,2
2530 DATA INCZ,2,NOGO,0,INX,1,SBCIM,2
2540 DATA NOP,1,NOGO,0,CPX,3,SBC,3,INC,3
2550 DATA NOGO,0,BEQ,2,SBCIY,2,NOGO,0
2560 DATA NOGO,0,NOGO,0,SBCZX,2,INCZX,2,NOGO,0
2570 DATA SED,1,SBCY,3,NOGO,0,NOGO,0
2580 DATA NOGO,0,SBCX,3,INCX,3,NOGO,0
2590 REM**HEX TABLE
2600 DATA 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F
```

Please note that in the graphics statements the ' ' symbol which represents 'SHIFT' has been replaced by the '©' symbol.

Further Reading

A wide range of books on 6502 programming techniques exist for those of you who wish to take the subject further. Some recommended titles are; **6502 Assembly Language Programming** by Leventhal, the series of 6502 books from Rodnay Zaks (make sure you get the second editions), and any information you can get from the suppliers, such as Rockwell, concerning the sofware.

Many of the various computers that use the 6502 have associated books on the machine code available and it is essential to obtain the relevant one if you are considering serious use of machine code.

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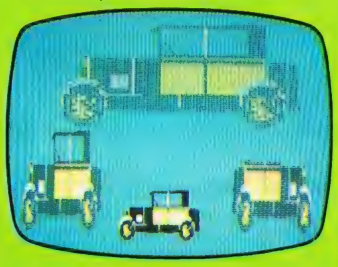

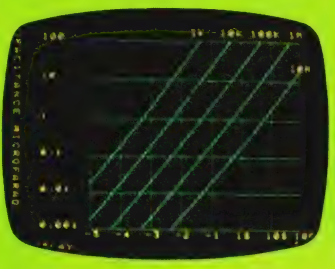

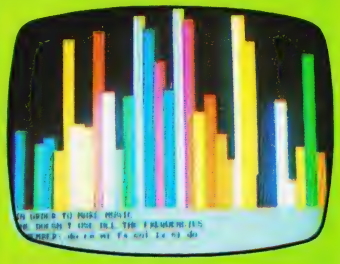

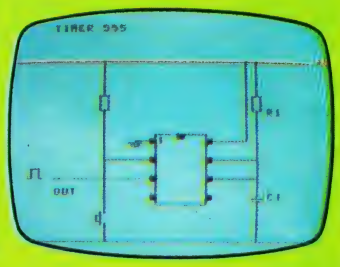

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NAME.

ADDRESS.

MY INTEREST IS:

Dear Sir,

In reply to the letter from H Bell in your May issue:
The Acorn ATOM does not normally give any problems when saving or loading tapes. Mr Bell should follow the instructions on page 8 of the ATOM manual in order to find the best setting of the cassette recorder's volume control.

When saving programs onto tape if the cassette recorder has a VU meter, the recording level should be set so that the needle of the VU meter points to the "0" marking.

When attempting to load programs, an initial check that the program has been saved correctly can be made by using the CAT command (see page 9 of the manual). The volume control of the cassette recorder should be adjusted until the correct program headings are printed on the screen. For example:

```
PROG1 2900 2900 0000 FF
```

Normally, the volume control will need to be set fairly low.

Some perhaps fairly obvious tips for Mr Bell:

1. Remember when recording to make sure that the tape head is well past the tape leader, and allow a few seconds for the drive to get up to full speed.
2. Keep the cassette recorder as far away from your television as possible to reduce the possibility of interference.

Yours faithfully,
Mr R M P Hanson
Pocklington,
Nr. York.

Dear Sir,

Please find enclosed an improved version of Phil Green's routine from his letter in the June issue. It is always better not to break the rules, even when being clever!

```
100 GOSUB 130
110 INPUT "DEC";A
120 GOSUB 150:PRINT "HEX":GOTO 110
130 DOKE 2048,1578:DOKE
    2050,-8440:DOKE 2052,-13978
140 DOKE 4100,2048:RETURN
150 DOKE 2054,A:X=USR(X):RETURN
```

Yours faithfully,
G C Norris
Wokingham.

Dear Sir,

This letter is to advise you that I am now the Secretary of the Computer Section of the Cornish Radio Amateur Club.

The section meets on the second Monday of each month at the SWEB Social Clubroom at 1900 hrs, when new members are made welcome. There is no need for members to have an interest in Radio to become a member; just contact Bob Reason, at the address below.

Yours faithfully,
W R Reason
'Kellita'
24 Mithell Rd
Camborne, Cornwall TR14 7JH

Dear Sir,

Referring to Softspot (June) Single Key BASIC for a UK101 by P Beckett. I have the new 'monitor' ROM from CompShop, so I have altered the program listing to suit.

```
63001 DATA 32,172,251
63002 DATA 108,2,201
63003 DATA 200,185,108,2
63004 DATA 208,233,200,185,108,2,240,13,
      224,70
63005 DATA 16,15,157,19,0,32,87,250
63006 DATA 200,185,108,2
63013 FOR I=552 TO 689
63016 POKE 536,40:POKE 537,2
```

The program now starts at 0228 and the table at 026C. The INPUT/OUTPUT VECTORS have been changed to FBAC/FA57.

I hope this will be of interest to your readers.

Yours faithfully,
R Funnell
Herts.

Dear Sir,

As Dealers in Nascom and Sharp Microcomputers we frequently encounter customers with a low opinion of cassette tape as a storage medium despite us knowing that the hardware is totally satisfactory. Such customers invariably ignore what we now believe to be the true cause — sub-standard cassette tapes! In common with other dealers we sell blank C10 or C12 cassette tapes believing them to be 'screened against drop-outs' and therefore suitable for the recording of digital data. After trying the wares of many suppliers of 'screened' tapes (this includes a number of well-known 'branded' products) we have now come to the conclusion that if, indeed, they are tested for drop-outs, then the test criteria are totally inadequate. We name no names because it seems that all suppliers offer the same (abysmally low) standard.

Among problems that we have so far encountered are:

- Errors because the tape gets creased by most normal cassette recorders.
- Errors because over-recording does not erase the old data.
- Errors because a tape is read fairly frequently and wears out very quickly.
- No (yes, NO!) oxide layer on the tape. (It took a long time trying to decide if this was a 'Read' error or a 'Write' error!)

When asked, suppliers invariably say that since no other customers have problems, 'it must be you' (does this mean all other customers are using low baud rates such as that used by TRS80 etc and can therefore be supplied with low quality tapes without repercussion?)

In view of this widespread problem, have any of your readers found a source of supply that is always reliable?

Yours sincerely,
Richard S Marshall
Chief Engineer,
Business & Leisure Micro Computers
16 The Square, Kenilworth CV8 1EB.

Dear Sir,

It may be of interest to the readers of Computing Today that we operate a Users' Group in the UK for the popular Sharp MZ80 Computer. Could you possibly include this notice in a forthcoming issue?

Sharp MZ80 Users' Club. Free Membership: extensive library and facilities. Details of meetings and Newsletters (SAE please) from: Paul Chappell, Computer Centre, Yeovil College, Yeovil, Somerset BA21 4AE.

Yours sincerely,
B R Thomas
Somerset.

Dear Sir,

With reference to last month's letter by J N Rolinson concerning the lack of an INKEY$ function on the ACORN ATOM, this can be easily rectified by use of the following:

```
P=#81;[JSR#FE71;STY#80;RTS]
```

After this a command of LINK#81 will scan the keyboard and return with the value of any key pressed in ?#80, if no key was pressed then ?#80 will contain the value of 255.

Alternatively a keyboard scan routine can be written either in BASIC or Assembler, which checks the rows of the keyboard matrix looking for a response, this method has the advantage that an ASCII conversion can be included if required (as the sub-routine at #FE71 does not convert to ASCII).

The SHIFT and CONTROL keys affect the keyboard port because they are not part of the keyboard matrix but are 'ON' all of the time and are thus only useful if simple INKEY$ functions are required.

D P Saville
Nottingham.

(*Many thanks to the dozens of people who wrote in with variations on this theme in reply to Mr Rolinson. We could have filled these two pages with the letters on this topic alone! Ed.*)

Dear Sir,

Owners of the ZX81 quickly realise its severe shortage of usable RAM. The obvious way out is to purchase the optional 16K RAM pack, but at £50, it may be more both in price and capacity than many wish to stretch to, at least until the bug has bitten!

A very useful extention can be made, with little effort which more than doubles the usable RAM.

The Hitachi HM 6116 2K x 8 Static RAM is pin compatible with the 4118 1K x 8 RAM fitted, and by shopping about may be obtained for less than £15, and prices are falling.

Remove IC4 (the 4118 RAM). Remove link L1 at the side of IC4 and fit link L2, carefully plug in the new HM 6116 observing the precautions necessary with CMOS.

Some owners may have two 2114 1K x 4 RAMs fitted. If so remove them both (but not the sockets).

Carefully solder in two rows of 12 Soldercon pins or a 24 pin DIL socket, with the centre spacing bars removed over IC4a's socket (check it is fitted correctly in the 24 pin IC4 position, not over the 28 pin markings). Fit link L2 and install the HM 6116. Refit PCB in case and test. Use the test program in chapter 23 of the ZX81 manual and see the difference.

For purchasers of ready-made ZX81s the case is held together with five small screws, three of which are located under the sponge feet, and the PCB is held in by two similar screws. Refit all screws in their original positions ie two short in board, two short in front holes of case and three long in rear holes.

Yours faithfully,
T J Cartwright
Leicester.

Dear Sir,

Despite warnings of 'SAVE' and 'LOAD' problems on the ZX80/81, I bought the cheapest tape recorder I could find. A Duette (?) battery/mains model for the princely sum of £9.95, brand new, complete. At that price I could just afford to be wrong. Provided the unused EAR or MIC lead is disconnected from the tape recorder to break a hum loop it LOADs and SAVEs without problem on my kit built ZX81 but then "That's the wonder of . . . . . " (Gloucester branch anyway).

Yours faithfully,
T Ladbrook
Melton Mowbray, Leicestershire.

Dear Sir,

With reference to my letter printed in the June issue regarding the correction to line 4130 in W S Lound's road race program, it appears that although my correction did allow the program to work, it was itself not entirely correct.

The letter from Jeff Tock in the May issue did include the correct modification.

I would like to apologise to any readers who may have been misled by my comments, and must add that I have learnt by this mistake to keep my big mouth shut in future.

Yours sincerely,
D J Woolnough
Beccles, Suffolk.

Dear Sir,

I am enclosing some information on our local computer club, which you may care to publish in your magazine.

The 'Merseyside Nascom Users Group' has elected to become an independent computer society. It was felt that with a membership of over 150 we were a little large for a 'splinter' group, and that the best interests of the members would be served in this way. Meetings are held on the first Wednesday of each month, in the 'Manx' Suite of the 'Mona Hotel' James Street, Liverpool — doors open 7.30 pm.

We try to have a guest speaker each night (Bit's & PC's and Vero in the recent past) and there are usually six or seven systems operating, so come along and have a 'natter'.

All visitors will be made very welcome, and whether you're 'into' computing, or just thinking about it — come along and see us.

Yours faithfully,
J Searle
Hon Sec.
14 Hawkshead Close,
Maghull,
Liverpool L31 9BT

Dear Sir,

We are three pupils at Rugby School, taking computer studies 'A' level (among others) this summer. We hope to procure jobs in the industry later in the year. We have been warned that 'A' level computer studies is **not** considered an adequate qualification for the kind of work we wish to pursue (design and development of mainframes and micros). Could you advise us as to whether this is the case? If so, what qualifications would you suggest we attempt?

Thanking you in advance,
Mark Pyman, Timothy Sheldon,
Ian Boston and James Ball
Rugby, Warwickshire.

(*Although A Level Computer Studies provides a very useful grounding in the field it does not come anywhere near the level required for the kind of work you wish to do. Companies will take you on but on the condition that you further your education by day-release courses at a Technical College or Polytechnic. The new TEC courses are generally a quicker way of reaching the necessary practical level as opposed to spending three years at University: in this field theory is generally learned faster by 'getting one's hands dirty'. Ed*)

Dear Sir,

The original concept of the NPCUA, founded in 1979, was to circulate programs, ideas and information between personal computer users and to involve members in national projects proposed by individuals.

We have learned from members all over the world that they are primarily concerned with extracting information as there is no incentive to provide it for the use of others. A cost-effective method of communicating via the computer as well as with it was therefore proposed and adopted and is now applied to all standard computers that save programs on tape.

Each member is provided with a C-10 cassette and an SAE. Original material worthy of transmission is saved on the tape while still in their computer and when the tape is full it is sent to us where it is copied and sent to other members. The member's original tape is loaded with other members' programs etc and sent back to him with another SAE. No pens, paper, envelopes or stamps to restrict the continual flow of information. The more often a cassette is sent to us and refilled with fresh information the more value-for-money for the subscriber. Additionally component suppliers can advertise to members through the Association resulting in discounts for members.

Owing to the financial support of the advertisers, annual subscriptions (including cassette, envelopes, labels and postage) are only £12 in the UK and £15 overseas, payable to the NPCUA with details of computer and monitor used. This scheme seems to have provided the elusive key to a true fraternity of computer users.

Yours faithfully,
Eric Keeley (G8XWM),
Secretary
National Personal Computer Users Association
11 Spratling Street
Manston, Ramsgate, Kent.

Dear Sir,

Following the publication of my article ZX80 2K EXTRA in the May issue of Computing Today, users may find difficulties if they are using over 8K of BASIC RAM. It will depend on the mode of decoding used, but may show itself when programming addresses over 24K.

This may be completely overcome by a simple change in the circuit of the 74LS02.

First replace the link between pins 6 and 10, by any signal diode with its cathode on pin 6. Then fit a 1k resistor between pins 6 and 11(A14). This will provide a — NOT A14 ENABLE — which will prevent any contention at high addresses.

Yours faithfully,
N J Petry
Weston-super-Mare.

Dear Sir,

I should be grateful if you would print the following in your Computer Club List

KENT
Would anyone interested in joining an informal computer club in the Tonbridge or Tunbridge Wells area please contact either Chris Wallwork (Tunbridge Wells 37682) or Ray Szatkowski (Tonbridge 355960).

Many Thanks,
Chris Wallwork
Tunbridge Wells
Kent.

Dear Sir,

As very satisfied educational users of North Star Horizons, we are urgently investigating the feasibility of running them under MP/M. Unfortunately, we are unable to locate a North Star implementation of the software.

We would be very grateful if you could publish this letter with our full address in the hope that one of your readers may be able to help in some way.

Thanking you,
Yours faithfully,
S A Bell
College of Further Education Plymouth
Kings Road,
Devonport
Plymouth PL1 5QC

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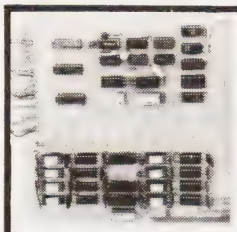

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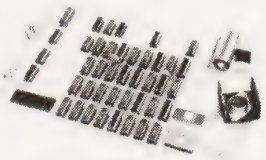

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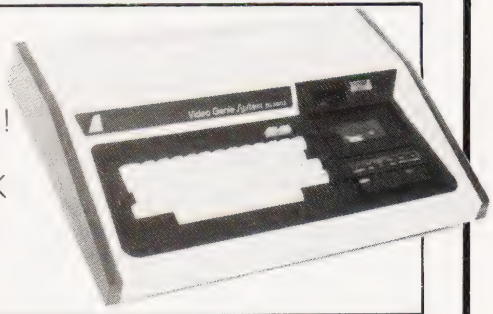

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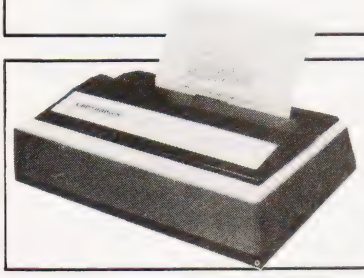

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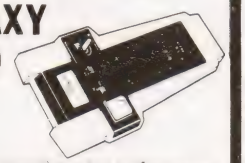

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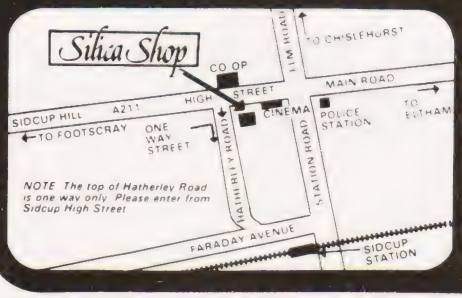

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The temple is inhabited by Monsters and Magical Beings. Your sword and arrows may be sufficient to destroy Gargoyles, Minotaurs, Mummies & The Cyclops etc., but you will need the various spells you find to combat JUBILEX, ASMODEUS, GERYON and the other magical beings. Beware also the Vampire Bats who will sap your strength requiring you to find a life-giving Elixir, and the SPIDER GODS whose attentions are usually fatal !

* * * * * * * * * * * * * * * *

The program requires 24K RAM and is exceptionally well presented. Nine chambers are depicted at one time with Monsters & Demons continually moving within their cells, and making 'real time' attacks. Swords flash, arrows fly & spells home-in on the victim! Each game is played against the clock & can be saved on tape after generating it — play it again & again. (Nascom BASIC/Graphics).

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CRYSTAL BALL

Tony Blewett

Character determination can be fun as this BASIC program shows

Numerological crystal ball is a lighthearted character assessment game that can produce lots of laughs when played using the names of friends, relatives and famous people (use discretion as well!)

It's based on the idea of allocating numbers to each letter of the alphabet, usually A = 1 through to Z = 26, then adding them repeatedly until only a single digit remains, in the range 1-9. This single digit is the person's 'magic' number.

For example, 'FRED' = 6 + 18 + 5 + 4 = 33, and 3 + 3 = 6. 6 is Fred's magic number, and is supposed to determine his character.

Program Details

The program as listed is optimised for use with a Tangerine computer TV display (screen size 32 characters x 16 lines) but would run on any system using Microsoft BASIC.

The clear screen routine at line 1000 produces 16 linefeeds when called; if you have 25 lines on your VDU then make line 1000 FOR A=0 TO 24 etc.

The heart of the program is the repeated digit adding process at lines 10-140. The subject's name is inputted to A$ at lines 20 (including spaces if desired). Line 35 counts how many spaces there are in variable S. Line 40 adds up the decimal ASCII values of the letters of A$ and stores them in variable B. Line 60 subtracts the ASCII offset, such that A = 1, B = 2 etc, subtracts any spaces, and stores the first sum in variable Z.

Lines 70-100 extract the individual digits of Z, and sums them again, the result being stored in variable E. If E is greater than 9, then a final addition of individual digits is made at lines 120-135, so that E is always in the range 1-9, the 'magic' number.

The multiway 'switch' at line 160 determines which of the character assessment output subroutines is selected. Change the wording of the subroutines to suit your own purpose, it's only fun anyway!

If you don't have the lower case option on your Tangerine, use upper case; I think a mixture looks better, that's all. You must use upper case letters as input in any case, or else the ASCII offsets will be incorrect.

Two sample runs are shown, what you think of the results is your affair!

```
Type the name of the person who is
the subject of this reading
? WINSTON CHURCHILL

The subjects' number is 1
Their main characteristics are:-
At best enormously forceful at worst
annoyingly obstinate. Individualistic,
having one track minds. Massive
ego. Either remarkable or a crashing
bore.

Do you wish to do any more studies?
Type Y/N
Y

Type the name of the person who is
the subject of this reading
? MARGARET THATCHER

The subjects' number is 4
Their main characteristics are:-
Inauspicious, dull and lacking in
imagination. Self-righteous and
respectable to a fault. At best can be
a pillar of society, capable of making
a positive contribution to it.

Do you wish to do any more studies?
Type Y/N
N
OK
```

Program Listing

```
 1 REM**PROGRAM FOR NUMEROLOGICAL CHARACTER
   ASSESSMENT.
 2 REM**WRITTEN FOR MICROTAN 65 +4K IN TANEX +
   BASIC IN ROM.
 3 GOSUB 1000
 5 PRINT"NUMEROLOGICAL CRYSTAL BALL":FOR I=0 TO 6:
   PRINT:NEXT
 7 PRINT"Type the name of the person who"
 9 PRINT"is the subject of this reading"
10 S=0:B=0
20 INPUT A$
30 FOR A=1 TO LEN(A$)
35 IF MID$(A$,A,1)=" [SPC]"THEN S=S+1
40 B=B+ASC(MID$(A$,A,1))
50 NEXT A
60 Z=B-S*32-((LEN(A$)-S)*64)
70 B=INT(Z/100)
80 C=INT((Z-B*100)/10)
90 D=INT(Z-B*100-C*10)
100 E=B+C+D
110 IF E<=9 THEN 150
120 F=INT(E/10)
130 G=E-F*10
135 E=F+G
140 GOTO 110
150 GOSUB 1000
158 PRINT"The subjects' number is";E
159 PRINT"Their main characteristics are:-"
160 ON E GOSUB 200,240,260,280,300,320,340,360,380
199 GOTO 500
200 PRINT"At best enormously forceful"
201 PRINT"at worst annoyingly obstinate"
202 PRINT"Individualistic, having one"
203 PRINT"track minds. Massive ego."
204 PRINT"Either remarkable or a crashing"
205 PRINT"bore"
206 RETURN
240 PRINT"Exhibit feminine characteristics"
241 PRINT"Reticent, willing to compromise"
242 PRINT"May seem placid and"
243 PRINT"ingratiating, but are plotting"
244 PRINT"all the time. Can be"
245 PRINT"genuinely sweet and have an"
246 PRINT"appealing quiet side"
247 RETURN
260 PRINT"Sparkling character, full of"
261 PRINT"life. Will draw good fortune"
262 PRINT"whatever they attempt. Acute"
263 PRINT"intellect and wit. Speaks with"
264 PRINT"charm and grace. A natural"
265 PRINT"winner"
266 RETURN
280 PRINT"Inauspicious, dull and lacking"
```

```
281 PRINT"in imagination. Self-righteous"
282 PRINT"and respectable to a fault"
283 PRINT"At best can be a pillar of"
284 PRINT"society, capable of"
285 PRINT"making a positive contribution"
286 PRINT"to it."
287 RETURN
300 PRINT"Make excellent (if not"
301 PRINT"faithful) bedmates. Extremely"
302 PRINT"attractive and energetic."
303 PRINT"Multiple interests and talents"
304 PRINT"but mercurial in nature"
305 PRINT"Dangerous to know, but fun"
306 PRINT"to watch!"
307 RETURN
320 PRINT"A paragon of domesticity and"
321 PRINT"harmony with an even temper"
322 PRINT"Fair minded and slow to anger"
323 PRINT"Make excellent wife/husband"
324 PRINT"conscientious parent and loyal"
325 PRINT"friend. Fun to be with (if you"
326 PRINT"can put up with their"
327 PRINT"occasional tendency to gossip)"
328 RETURN
340 PRINT"Secretive, stand-offish,"
341 PRINT"disciplined and haughty"
342 PRINT"Mysterious, often hiding"
343 PRINT"something — unhappiness"
344 PRINT"world-weariness or disillusion-"
345 PRINT"ment. Can be bitter, disdainful"
346 PRINT"and sarcastic"
347 RETURN
360 PRINT"Absolute determination to"
361 PRINT"succeed in life. Tough,"
362 PRINT"single minded in purpose, but"
363 PRINT"win or lose they 'do it big'"
364 PRINT"Sometimes miserly, and"
365 PRINT"materialistic"
366 RETURN
380 PRINT"A wise counsellor, spiritual"
381 PRINT"leader, seeker-after and"
382 PRINT"teacher-of truth. Idealist"
383 PRINT"in the highest sense of the"
384 PRINT"word. Strongly passionate"
385 PRINT"and possessed of durable will"
386 PRINT"Impulsive, romantic and"
387 PRINT"remarkable person"
388 RETURN
500 PRINT:PRINT"Do you wish to do any more"
501 PRINT"studies? Type Y/N"
502 GET Z$
503 IF Z$="Y" THEN 1
504 IF Z$="N" THEN 999
505 PRINT"RESPONSE NOT RECOGNISED"
506 GOTO 500
999 END
1000 FOR A=0 TO 15:PRINT:NEXT:RETURN
```

AREA CALCULATOR

Bob Sharp

Discover just how much room you've got

Further to Mr Holson's letter in the September issue, the following progam may be of interest. Produced for the ZX80 and using only the 1K of RAM it will calculate the area within a polygon. The formula contained in line 238 is similar to that proposed by Mr Holson. The computer plots the points whose co-ordinates have been entered, using a 36 symbol code, and the area is printed underneath. The sign of the area will be positive if traced anti-clockwise and negative if all, or any, of the figure is plotted clockwise. On the display the plotted points are displayed in the same code as the axes and are numbered according to the order of entry.

In the entry stage of line 80 and 90 inputs of greater value than 32 and 21 respectively will not be displayed although the area is still calculated. All the input co-ordinates are repeated after entry for checking, NEWLINE will cause the program to continue if they are correct.

Program Listing

```
 10 PRINT "HOW MANY VERTICES?"
 20 INPUT V
 30 CLS
 40 PRINT "GIVE CO-ORDINATES"
 50 DIM X(V-1)
 60 DIM Y(V-1)
 70 FOR N=0 TO V-1
 80 INPUT X(N)
 90 INPUT Y(N)
100 PRINT "(";X(N);",";Y(N);")"
110 NEXT N
120 INPUT A$
130 CLS
140 FOR N=1 TO 20
150 LET Y=21-N
160 PRINT CHR$(156+Y)
170 FOR P=0 TO V-1
180 IF Y=Y(P) THEN GOTO 210
190 NEXT P
200 GOTO 290
210 FOR X=1 TO 31
220 FOR Q=0 TO V-1
230 IF Y=Y(Q) AND X=X(Q) THEN GOTO 270
240 NEXT Q
250 PRINT " ";
260 GOTO 280
270 PRINT CHR$(Q+156);
280 NEXT X
290 PRINT
300 NEXT N
310 FOR N=0 TO 31
320 PRINT CHR$(156+N);
330 NEXT N
340 LET Z=0
350 FOR R=0 TO V-1
360 LET S=R+1-((R+1)/V)*V
370 LET T=R+2-((R+2)/V)*V
380 LET Z=Z+X(S)*(Y(T)-Y(R))
390 NEXT R
400 PRINT "AREA IS";Z/2;
410 IF NOT (Z/2)*2=Z THEN PRINT "1/2";
420 PRINT "SQUARE UNITS"
```

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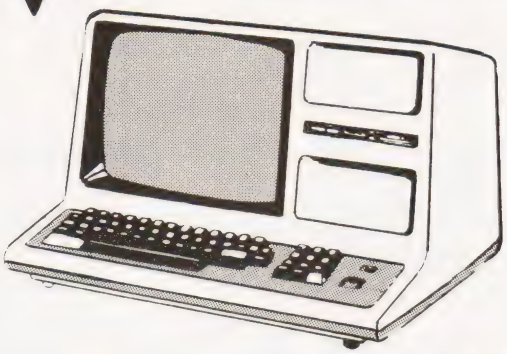

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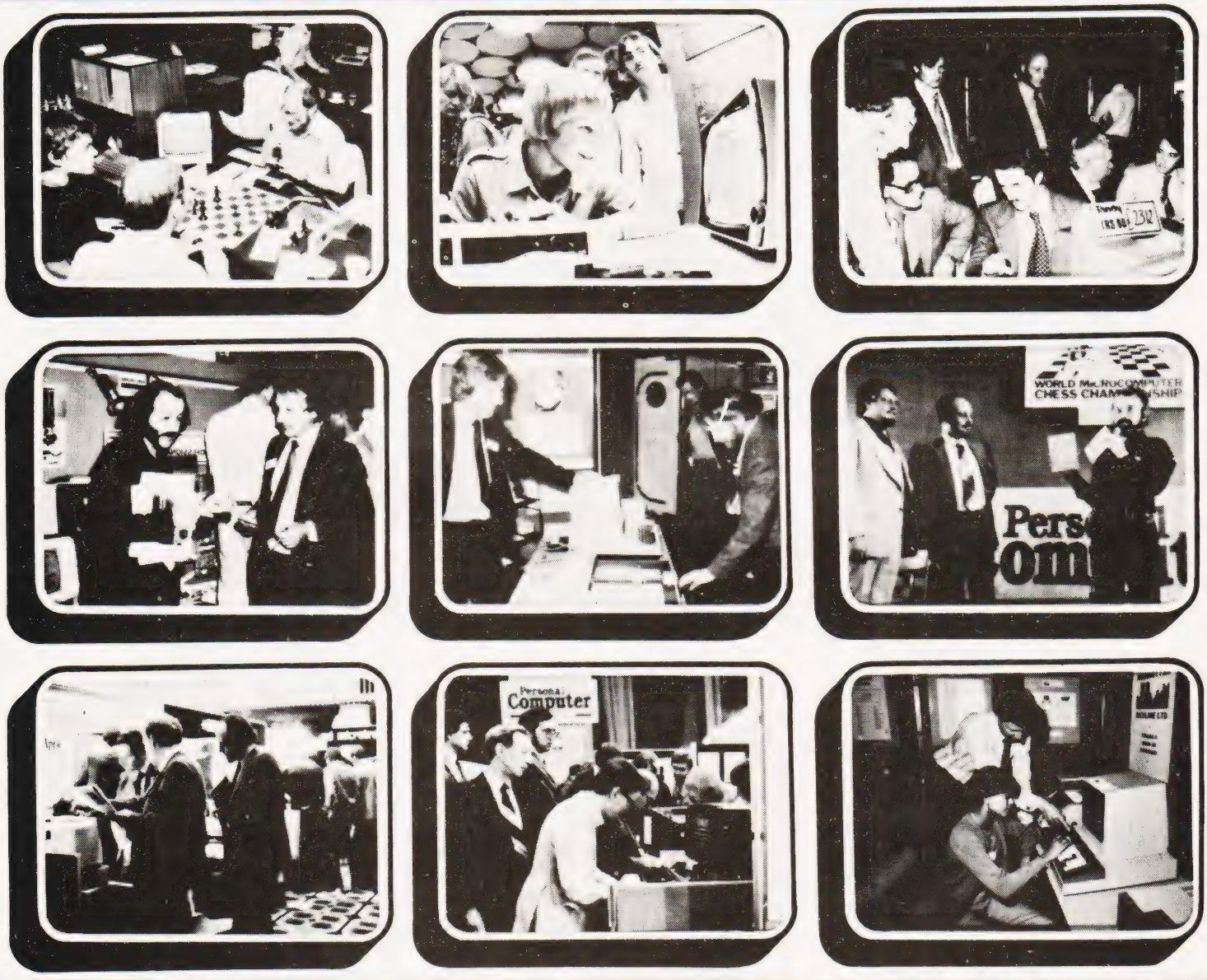

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Once again we look at the systems market and include all the new machinery.

The next few pages of the magazine are given over each month to a comprehensive guide to what's available on the UK computer market. The information is intended to be used as a quick reference to the vital statistics of the various micros, both by people looking to make their first purchase and those seeking to upgrade. The purpose of this 'Guide to the Guide' is to explain how to interpret the information that follows in order to get the most out of it.

From The Top

Each bold type section contains the range of computers manufactured by that company. The actual manufacturer may not be involved in direct selling to the public, Atari for example. In cases like this we give you the name and address of the major UK distributor.

The next important detail is the type of **CPU** that's used in the computer. If your requirements call for a specific CPU this entry is essential, if you are merely interested in high-level language programming then the CPU is probably not so critical.

Remember Remember

The computer's memory capacity is the next item on the list. **RAM** stands for Random Access Memory, the kind you load your programs into as opposed to ROM(Read Only Memory) which is what the manufacturer loads his software into. Generally one figure is quoted and this is the amount that is supplied with the basic machine, 48K for example. If there are two figures, 8K/32K as in the case of the Commodore PET, this indicates the range of memory that's available.

The 'K' stands for 'binary thousand' (1024) and so an 8K machine contains 8192 bytes of user memory. A byte is a collection of eight bits and is the basic unit of computer storage. Most of the systems in the Guide are based on eight bit microprocessors and these have an addressing capability of 64K, that's 65,536 bytes. Sometimes you may see a figure greater than this in the RAM entry, it's not a misprint, and in these cases the manufacturer is using a special technique called 'bank selection' to increase the amount of memory that can be supplied, 227K in the case of the NASCOM.

Storage And I/O

When you have produced a computer program that works you will want to store it away somewhere, it disappears from RAM when you turn the power off. The usual method for personal computers is to use a conventional cassette recorder, special tape is recommended. The **CASS** entry tells you whether this facility exists and to what standard, if known. Typical standards here are CUTS, short for Computer Users Tape System, and Kansas City, named after the place where the standard was defined. These convert the digital information inside the computer into a series of tones which can be recorded onto magnetic tape. The speed of storage and retrieval is worth checking, a fast speed such as 1200 or 2400 baud is convenient but inherently less reliable than a slow speed such as 300 baud. The term baud originally came from the telegraphic industry and refers to the number of transitions occurring per second, it is *not* the number of bytes that are transferred per second. Ideally your computer should offer a choice of baud rates, 300 and 1200 is a typical example, and this allows you to save a master copy for security and make a second, faster version for day-to-day use.

A more expensive but generally faster and more flexible (no pun intended) method of storing programs is the floppy disc and this is shown in the **DISC** entry. These come in two sizes, 5¼" and 8", and are available in single and double sided and single and double density versions as well as combinations of the two. Obviously you'll be able to fit more onto an 8" disc than a 5¼" one and these tend to be used in professional and small business systems as they are more suited to the heavy usage. For people with a lot of information to store there is another type of disc knowns as a 'hard disc', shown as Hd in the list. These are capable of holding millions of bytes as opposed to the tens or hundreds of thousands found on the floppy disc. They do, however, carry a large price tag. A typical example of a hard disc based system is the Cromemco Z2H which is fitted with a 10Mb (megabyte) Winchester technology hard disc unit.

Getting the information in and out of the computer to a printer or a Visual Display Unit requires the computer to have input/output capability and this is indicated by **I/O** in the table. There are three major types of I/O and two specials. The most common type is serial, indicated by SER, and this can be RS232, V24 or 20mA depending on the peripheral being used. The second type is parallel, indicated by PARA, which is effectively just an extension of the computer's data bus with some control capability built in — an oversimplification but easier to visualise. The third type that is commonly found is IEEE which is a special sort of parallel interface that allows many different peripherals to share the same connection to the computer. It is normally found in machines that are used in a scientific environment, the PET is a notable exception.

The two specialised forms of I/O are the dedicated printer port, shown as PARA.P, which allows a Centronics type printer to be fitted and the bus which is used for the expansion of the system, S50 and S100 are typical.

The Soft Edge

If you are intending to program in a high level language, one that uses words rather than the machine code of the CPU, then look at the entries beside **BASIC** and **Other**. The most common language is BASIC although others such as Pascal are rapidly gaining in popularity. The **m/c** entry is also important here because it indicates whether the system will allow you to program it in machine code, the number indicates the amount of ROM that the manufacturer has fitted his monitor into.

An entry such as CP/M in the m/c slot shows that the discs are running under control of a Disc Operating System, DOS for short, and this often gives you access to a large quantity of ready-made programs and languages.

The Price You Pay

The figure in the **£** entry is obviously the price of the given system. Although these are checked regularly for their accuracy the manufacturers do tend to change them at short notice so it is well worth checking.

The **Extras** and **Applications** entries give a brief idea of the support and expansion capabilities of the system and the area in which it is likely to perform best.

When you have compiled a short-list of the systems that seem to meet your needs you should try to get 'hands-on' experience with them. Always make sure that your dealer is a recognised one and, if possible, ensure that he is a member of the Computer Retailers Association, the CRA.

Over the years Computing Today has **Reviewed** many of the systems listed here and those that we have looked at are indicated. Copies of the reviews are available from our offices, they cost £1 each.

ABC Computers

ABC-24
Dist:- Sun Computing Services,
138 Chalmers Way,
North Feltham Trading Estate,
Middx TW14 0UN
01-751 5044
Also from Ragen International

CPU	Z80A
RAM	64K
I/O	2 SER GPIB
CASS	–
BASIC	Various
Other	Various
DISC	2x5¼" 640Kb
m/c	CP/M, MP/M

Approx. **£**3,000

Extras:- More discs, various CP/M software.
Applications:- Desktop small business system with integral VDU.

ABC-26

CPU	Z80A
RAM	64K
I/O	2 SER GPIB
CASS	–
BASIC	Various
Other	Various
DISC	2x8" 2.3Mb
m/c	CP/M MP/M

Approx **£**4,000

Applications:- As ABC-24 but with increased storage capacity.

ACT Microcomputers

SYSTEM 800
Dist:- ACT (Computers),
Radclyffe House,
66-68 Hagley Rd, Edgbaston,
Birmingham, B16 8PF
021-455 8686
+ growing regional network

CPU	6502
RAM	46K
I/O	SER PARA
CASS	N/A
BASIC	Yes
Other	Various
DISC	2x5¼''
m/c	MDOS

£3,950-8,950

Extras:- 8'' disc, printers, modems
Applications:- Stand alone business system that can also run most PET software.

Acorn Computers

ATOM
Dist:- Acorn Computers
4A Market Hill, Cambridge
0223-312772.

CPU	6502
RAM	2K/11K
I/O	BUS PARA
CASS	CUTS
BASIC	8K
Other	FP option
DISC	
m/c	YES

£125 kit, £150 built

Extras:- Colour graphics, enhanced BASIC
Applications:- Cased single board with BASIC, can connect to Eurobus
Reviewed:- April '81

ACORN
Dist:- As ATOM

CPU	6502
RAM	1K/8K
I/O	PARA BUS
CASS	CUTS
BASIC	NO
Other	NO
DISC	NO
m/c	2K

£65 upwards

Extras:- Rack based expansion capability inc Prestel.
Applications:- Single board controller with piggy back Hex + I/O.
Reviewed:- Aug '79

Adler Business Systems

ALPHATRONIC P1
Dist:- Adler Business Systems Ltd.,
27 Goswell Road, London EC1M 7AJ.
01-250 1717

CPU	8085A
RAM	48K
I/O	2 SER, BUS
CASS	–
BASIC	Extended
Other	Soon
DISC	5¼" DD
m/c	CP/M

£1,550-2,345

Extras:- Second 5¼" drive.
Applications:- Small business desktop system with detached 12" screen and optional printer.

ADDS

ADDS SYSTEM 75
Dist:- ADDS (UK) Ltd.
137 High Street,
New Malden, Surrey.
01-949 1272
Sold through dealer network.

CPU	8085A
RAM	52K
I/O	SER COMS
CASS	N/A
BASIC	YES
Other	FORTRAN uCOBOL
DISC	2x8"
m/c	ADOS

£4,000 upwards, less printer

Extras:- Floppy, printer, system software
Applications:- Complete business system with supplied software and communications interface

Apple Computers

APPLE II
Dist:- Microsense,
Finway Road, Maylands Ave,
Hemel Hempstead, Herts HP2 7LE.
0442-48151
Over 200 regional dealers

CPU	6502
RAM	16K/48K
I/O	Various
CASS	1500 bps
BASIC	2 versions
Other	Various
DISC	OPT
m/c	2K

£695 upwards

Extras:- Various discs, colour graphics, I/O
Applications:- Neat cased system with excellent I/O capability including Prestel

APPLE III

CPU	6502A
RAM	96K/128K
I/O	Various
CASS	–
BASIC	Business BASIC
Other	Pascal, FORTRAN
DISC	5¼"
m/c	Apple SOS

Approx **£**2,500

Extras:- Up to three more discs. Wide range of peripherals
Applications:- Small business machine but still has overtones of the "personal" market

Archive

ARCHIVE BUSINESS COMPUTER
Dist:- Salmon Electronics,
PO Box 26, Croft-on-Tees,
Darlington DL2 2TN
0325-721368

CPU	Z80A
RAM	–
I/O	SER PARA
CASS	–
BASIC	YES
Other	Various
DISC	2x5¼"
m/c	CP/M

£3,400

Extras:- Cartridge and Winchester discs.
Applications:- Small business S100 based system, price includes Wordstar.

Atari

ATARI 400
Dist:- Ingersoll Electronics
202 New North Road,
London N1 7BL.
01-226 1200

CPU	6502
RAM	8K/16K
I/O	SER
CASS	YES
BASIC	18K
Other	
DISC	
m/c	shared

£400

Extras:- Printer
Applications:- Programmable games system grown up to home computer.

ATARI 800

CPU	6502
RAM	16K/48K
I/O	SER
CASS	YES
BASIC	18K
Other	
DISC	
m/c	shared

£750

Extras:- Printer, discs, plug in software, modem
Applications:- Expanded version of 400 with wider applications

Athena

ATHENA 8285
Dist:- Butel-Comco Ltd.
50 Oxford Street,
Southampton, Hants SO1 1DL.
0703-39890

CPU 8085A
RAM 64K
I/O SER
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c DOS

£3,380 upwards

Extras:- 8" discs, printer, wide range of software
Applications:- Complete integral desktop system

Attache

ATTACHE
Dist:- Friargrove Systems,
Suite 62, Outer Temple,
222 The Strand,
London WC2R 1BA

CPU Z80
RAM 64K
I/O SER
CASS N/A
BASIC YES
Other Various
DISC 2x8"
m/c CP/M
£8,000

Extras:- Hard disc,
Applications:- Complete S100 based system with VDU, printer and software

Cifer

CIFER 2684
Dist:- Roham Computing,
52 Coventry Street, Southam,
Warwickshire CV33 0EP
092681-4045

CPU DUAL Z80
RAM 64K
I/O 3 SER, PARA.P, IEEE
CASS –
BASIC Various
Other Various
DISC Single 5¼"
m/c CP/M
£1,764-2,234

Extras:- Up to four 5¼" or 8" floppies, orange or green VDU.
Applications:- VDU based system with single integral disc. Business and scientific.

Comart

COMMUNICATOR
Dist:- Comart Ltd.,
PO Box 2, St. Neots,
Huntington, Cambs PE19 4NY
0480-215005

CPU Z80A
RAM 64K
I/O 2 SER PARA.P
CASS –
BASIC YES
Other YES
DISC 2x5¼"
m/c CP/M
£1,750 upwards

Extras:- Various disc capacities, Winchester and cartridge options.
Applications:- S100 based system of British make, also available with multi-user capability as the Educator.

Commodore Systems

PET
Dist:- Commodore,
360 Euston Road, London NW1 3BL.
01-388 5702
+ many regional dealers.

CPU 6502
RAM 8K/32K
I/O IEEE PARA
CASS YES
BASIC 8K Microsoft
Other Forth Pascal COMAL
DISC OPT
m/c TIM (16 & 32K only)
£550 upwards

Extras:- Discs, printer, many options
Applications:- Original complete personal system
Reviewed:- December '79

SUPER PET (8032)

CPU 6502
RAM 32K
I/O IEEE PARA
CASS YES
BASIC BASIC 4.0
Other Pascal
m/c TIM
DISC OPT
£700 approx

Extras:- 5¼" discs. Choice of printers, range of business software
Applications:- "Super" personal computer or small business machine

VIC-20

CPU 6502
RAM 3K/32K
I/O IEEE PARA
CASS YES
BASIC As PET
Other –
DISC –
m/c –

Extras:- More memory, RS232 interface.
Applications:- Personal system with colour and sound. BASIC is generally compatible with PET but screen format is not.

Compshop

UK 101
Dist:- CompShop
14 Station Road, New Barnet,
Herts EN5 1QW
01-441 2922

CPU 6502
RAM 4K/32K
I/O SER PARA
CASS YES
BASIC 8K Microsoft
Other NO
DISC
m/c 2K
£149 kit, £199 built

Extras:- Memory, I/O, kit or built
Applications:- UK implementation of Superboard

Compucolor

COMPUCOLOR II
Dist:- Dyad Developments,
The Priory, Great Milton,
Oxon OX9 7PB
08446-729.

CPU 8080
RAM 8K/32K
I/O SER PARA
CASS NO
BASIC YES
Other NO
DISC 5¼"
m/c DOS
£1,200

Extras:- Second disc unit.
Applications:- Integral colour graphics system with limited expansion capabilities.
Reviewed:- June '79 & July '80

Cromemco

CROMEMCO SYSTEM 2
Dist:- Comart Ltd,
PO Box 2, St Neots,
Huntingdon, Cambs PE19 4NY.
0480-215005
plus Datron & Edinburgh Micro Centre

CPU Z80
RAM 64K
I/O SER PARA.P
CASS N/A
BASIC Various
Other Various
DISC 2x5¼"
m/c CDOS
£2,095-£7,000

Extras:- Hard option disc, multiple user capability, printer, etc.
Applications:- Development system, S100 based, with a wide range of software

CROMEMCO Z2H

CPU Z80A
RAM 64K
I/O SER PARA.P
CASS N/A
BASIC Various
Other Various
DISC 10Mb Hd
m/c CDOS
£5,373 upwards.

Extras:- Up to 6 hard discs, 8" floppies
Applications:- Development system, Fast data processor and data base with multi-user capability.

CROMEMCO SYSTEM 3

CPU Z80A
RAM 64K
I/O SER PARA.P
CASS N/A
BASIC Various
Other Various
DISC 2x8"
m/c CDOS
£3,745-£9,000

Extras:- Discs (inc hard), multi-user capability, printers, etc.
Applications:- S100 based professional system with a wide range of applications.

DAI

DAI PERSONAL COMPUTER
Dist:- Data Applications (UK) Ltd.,
16B Dyer Street,
Cirencester, Glos GL7 2PF
0285-61828

CPU 8080A
RAM 48K
I/O SER BUS
CASS 2
BASIC Semi-compiling
Other –
DISC Soon
m/c YES
£595

Extras:- Hardware maths package, industrial interfaces.
Applications:- Full colour, personal computer with very powerful BASIC.
Reviewed:- August '81

Digital Microsystems

DSC-2
Dist:- Modata Ltd,
30 St Johns Road, Tunbridge Wells,
Kent TN4 9NT.
0892-41555.

CPU Z80A
RAM 64K
I/O SER PARA
CASS N/A
BASIC Yes
Other Various
DISC 2x8"
m/c CP/M
£3,525-7,645

Extras:- Hard disc, extra floppies, various software
Applications:- Business machine of US origin.

DSC-3

CPU Z80A
RAM 64K
I/O SER PARA
CASS N/A
BASIC Yes
Other Various
DISC 2x8"
m/c CP/M
£3,445-6,995

Extras:- Hard disc, extra floppies.
Applications:- Can use one serial interface in RS422 mode and act as a Master/Slave in a network.

HDS-4000

CPU Z80A
RAM 64K
I/O SER PARA
CASS N/A
BASIC Yes
Other Various
DISC 2x8" + Hd
m/c CP/M
£6,745-7,645

Extras:- More disc storage
Applications:- Choice of two sizes of hard disc make for medium sized DP use.

Equinox

Series 5000
Dist:- Equinox Computer Systems,
16 Anning Street, New Inn Yard,
London EC2A 3HB.
01-739 2387.

CPU Z80
RAM 16K/56K
I/O 2 SER PARA
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c CP/M
£1,500 - £2,500

Applications:- S100 based commercial, scientific or educational usage

Equinox 200

CPU Z80
RAM 64K/512K
I/O 6 SER PARA
CASS N/A
BASIC YES
Other Various
DISC 10 Mb Cart
m/c –
£7,500 upwards

Extras:- Cartridge discs up to 1200 Mb
Applications:- Cartridge disc based S100 multi user system

Equinox 300

CPU 16 bit
RAM 64K/256K
I/O 6 SER
CASS N/A
BASIC YES
Other –
DISC 10 Mb Cart
m/c –
£10,000 upwards

Extras:- Cartridge discs up to 1200 Mb
Applications:- Sixteen bit micro based multi-user system

Series 8000

CPU Z80
RAM 64K/256K
I/O 2 SER 1 PARA
CASS N/A
BASIC YES
Other Various
DISC 2-4 8"
m/c CP/M
£2,500 - £5,000

Applications:- Multi user upgrade of 5000 with greatly increased storage capacity

Eurocalc

EUROC
Dist:- Eurocalc Ltd,
128/132 Curtain Road,
London EC2.
01-729 4555.
+ Regional Distribution network soon

CPU 8080
RAM 64K
I/O PARA
CASS N/A
BASIC YES
Other Various
DISC 2x8"
m/c CP/M
£8,000

Extras:- Printers, WP keyboard, hard disc
Applications:- Plessey manufactured system supplied complete with software and hardware.

Exidy

SORCERER
Dist:- Liverport Data Products,
The Ivory Works,
St. Ives, Cornwall.
0736-798157.
+ regional dealers.

CPU Z80
RAM 16K/48K
I/O SER PARA
CASS 2
BASIC Plug In 8K
Other On disc
DISC OPT
m/c 4K
£749 upwards

Extras:- Discs, printer, S100 adapter, ROM PACs.
Applications:- Keyboard based system using 'plug-in' software and expanding to discs.

Gemini

GEMINI
Manuf.:- Gemini Microcomputers,
Oakfield Corner, Sycamore Road,
Amersham, Bucks.
02403-22307.

CPU Z80A
RAM 64K
I/O Serial
CASS N/A
BASIC YES
Other –
DISC 2x5¼"
m/c CP/M
£575 - **£**1,075

Heath Electronics

HEATHKIT H8
Dist:- Heath Electronics,
Bristol Road, Gloucester GL2 6EE.
0342-29451.
+ London shop (01-636 7349).

CPU 8080
RAM 4K/56K
I/O Various
CASS 300/1200 baud
BASIC YES
Other Various on disc
DISC OPT
m/c 4K
£275 upwards

Extras:- Discs, printer, VDU
Applications:- Bus based kit system of superb quality, large expansion possible

Hewart Microelectronics

HEWART 6800S
Dist:- Hewart Microelectronics,
95 Blakelow Road, Macclesfield,
Cheshire SK11 7ED.
0625-22030.

CPU 6800
RAM 16K/32K

I/O SER PARA
CASS 2
BASIC OPT 8K
Other Pascal
DISC
m/c 1K/2K
£299 inc. keyboard

Extras:- 6809 upgrade, floppy discs using FLEX, case
Applications:- Naked 6800 development system.

HEWART 6800 MK4

CPU 6800
RAM 16K/48K
I/O Choice
CASS 2
BASIC OPT
Other OPT
DISC OPT
m/c 1K
£160 upwards.

Extras:- SS50 range of boards.
Applications:- Naked bus based system, found useful in education/control.

Hewlett Packard

HP 85A
Dist:- Hewlett Packard,
Personal Computation Group,
308-314 Kings Road, Reading,
Berkshire.
0734-61022.

CPU CUSTOM
RAM 16K/32K
I/O IEEE, BCD, SER, GPIO
CASS CART
BASIC 32K
Other Assembler
DISC OPT
m/c NO
£2,012 inc VAT

Extras:- All HP range of goodies.
Applications:- Integral printer system for desktop scientific use.
Reviewed:- April '80 & June '80

HP83

CPU Custom
RAM 16K/32K
I/O IEEE, SER, BCD, GP10
CASS —
BASIC 32K
Other Assembler
DISC OPT
m/c No
£1,391 inc VAT

Extras:- All HP range of goodies.
Applications:- As the HP85 but without integral printer and tape cartridge units.

Interec Data Systems

SUPERBRAIN
Dist:- Sun Computers,
138 Chalmers Way,
North Feltham Trading Estate,
Feltham, Middx.
01-751 6695.
Many other UK sources including Camden Electronics.

CPU 2xZ80
RAM 32K/64K
I/O SER
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c CP/M
£1,950 upwards

Extras:- 8" disc, standard software.
Applications:- Smart desktop system for small business use. Can be expanded using S100 bus.

Ithaca Intersystems

ITHACA INTERSYSTEM 2
Dist:- Transam,
59-61 Theobalds Road,
London WC1.
01-405 5240.
+ regional dealers.

CPU Z80A
RAM 8K/64K
I/O Various
CASS N/A
BASIC YES
Other Various
DISC 5¼" or 8"
m/c CP/M
£700 upward

Extras:- Full range of S100 boards to IEEE spec.
Applications:- Flexible system that can be adapted to a wide range of uses.

ITT Consumer Products

ITT 2020
Dist:- Telefusion Ltd.,
61 Queens Square, Bristol.
0272-211446.
+ many regional stockists.

CPU 6502
RAM 16K/48K
I/O Various
CASS YES
BASIC Various
Other Pascal
DISC OPT
m/c 2K
£750 - £1,500

Extras:- Discs, Prestel, printers.
Applications:- As Apple II, compatible UK version with standard colour graphics.
Reviewed:- March '80

LSI Computers

SYSTEM M-TWO
Dist:- LSI Computers,
Copse Road, St. Johns,
Woking, Surrey GU21 1SX.
04862-23411.

CPU 8085
RAM 64K
I/O SER
CASS —
BASIC YES
Other —
DISC 2x8" 1 x Hd
m/c —

Applications:- Small to medium sized business

Luxor

ABC 80
Dist:- Datormark Ltd.,
Fox Oak, Seven Hills Road,
Walton-on-Thames, Surrey KT12 4DG
Weybridge 44896

CPU Z80A
RAM 16K/40K
I/O IEEE SER
CASS Yes 700 baud
BASIC 16K
Other Pascal
DISC 2x5¼"
m/c 2K
£749

Extras:- Mainly software, I/O
Applications:- Complete cased system, Viewdata compatible

Memory Computers

SYSTEM 7101
Dist:- Memory Computers (UK) Limited,
Britannia House,
960 High Road,
London N12 9RY.

CPU Z80
RAM 64K/256K
I/O 2 SER, 1 PARA
CASS —
BASIC Microsoft V5.2
Other Various
DISC 2 or 4x5¼" DSDD
m/c 4K/CP/M
£5,950 inc printer

Extras:- Four 8" floppies, 10Mb Winchester, extra printer.
Applications:- Complete VDU based system with Intelligent Terminal capability, well established in Europe.

Microdata Computers

MICROLINK 1
Dist:- Microdata Computers,
Belvedere Works, Bilton Way,
Pump Lane Industrial Estate,
Hayes, Middx UB3 3ND.
01-848 9871.

CPU Z80/F8
RAM 16K/32K
I/O SER PARA
CASS CUTS 1200 baud
BASIC 8K
Other Pascal soon
DISC NO
m/c 3K
£3,500 upwards

Extras:- Printer, modem, etc.
Applications:- Portable data terminal using plasma flat screen display

Micro V

MICROSTAR 45
Dist:- Microsense
Finway Road, Maylands Avenue,
Hemel Hempstead, Herts HP2 7LE.
0442-48151.
+ small dealer network.

CPU 8085A
RAM 64K
I/O SER
CASS N/A

BASIC YES
Other Various
DISC 2x8"
m/c *DOS CP/M
£4,800

Extras:- 20 Mb hard disc, VDU, printer
Applications:- Multi user business system

Midwest Scientific Instruments

MSI 6800 SYSTEMS
Dist:- Strumech,
Portland House, Coppice Side,
Brownhills, Walsall,
West Midlands.
05433-4321.

CPU 6800
RAM 16K/56K
I/O SER
CASS OPT
BASIC YES
Other Various
DISC OPT
m/c 1K + FDOS
£1,200 upwards

Extras:- Floppies, hard disc, printer, VDU.
Applications:- Ready built SS50 system expanding to full "System 12" with hard disc.

Nascom Microcomputers

NASCOM 1
Dist:- Nascom,
Welton Road, Wedgnock Industrial Estate,
Warwick CV34 5PZ.
0926-497733.

CPU Z80
RAM 1K/227K
I/O SER PARA
CASS YES
BASIC OPT
Other
DISC
m/c 1K
£125

Extras:- Motherboard, RAM, printer.
Applications:- Full keyboard machine code system, expandable.

NASCOM 2

CPU Z80A
RAM 1K/227K
I/O SER PARA
CASS Kansas
BASIC 8K Microsoft
Other Pascal
DISC Opt
m/c 2K monitor + CP/M
£225

Extras:- Printer, RAM, case, discs.
Applications:- Low cost kit system, developed from Nascom 1.
Reviewed:- February '80

National Panasonic

PANASONIC JD800/840
Dist:- Panasonic Business Equip.,
9 Connaught Street,
London W2 2AY.
01-262 3121.
+ regional distributors.

CPU 8085A
RAM 56K
I/O SER
CASS N/A
BASIC YES
Other COBOL
DISC 2x8"
m/c CP/M
£4,275 (hardware), £8,000 upwards for packages

Extras:- Printers and software from regional distributors.
Applications:- Complete small business system with software support.

Netronics

ELF II
Dist:- Newtronics,
255 Archway Road,
London N6.
01-348 3325.

CPU 1802
RAM ¼/4K
I/O PARA
CASS OPT
BASIC OPT
Other
DISC
m/c 1K
£60

Extras:- Motherboard, RAM, I/O.
Applications:- Low cost kit for Hex programming.
Reviewed:- October '79

EXPLORER 85

CPU 8085
RAM 4K
I/O PARA
CASS YES
BASIC 8K OPT
Other
DISC
m/c 2K
£285 upwards

Extras:- Normal S100 goodies, case.
Applications:- Kit, S100 based.
Reviewed:- June '80

Newbear

77-68
Dist:- Newbear,
40 Bartholomew Street,
Newbury, Berks.
0635-30505.
+ 2 regional shops.

CPU 6800
RAM 4K/56K
I/O Various
CASS YES
BASIC OPT
Other NO
DISC
m/c 1K
£40 upwards

Extras:- 6809 upgrade, I/O, discs.
Applications:- Rack based kit system.

North Star

NORTHSTAR HORIZON
Dist:- Comart Ltd.,
P.O. Box 2, St Neots,
Huntingdon, Cambs PE19 4NY.
0480-215005.
+ many regional dealers.

Extras:- Discs, VDU, printer.
Applications:- S100 based system with good software support.

CPU Z80
RAM 32K/56K
I/O SER PARA
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c CP/M
£1,600 - 2,000

Ohio Scientific Instruments

SUPERBOARD II, (C1)
Dist:- Mutek,
Quarry Hill, Box, Wiltshire.
0225-743289.
+ many regional

CPU 6502
RAM 4K/32K
I/O PARA BUS
CASS YES
BASIC 8K Microsoft
Other NO
DISC NO
m/c 2K
£150 cased + psu + mod = C1 @ £220

Extras:- Discs, Memory, case.
Applications:- Naked single board with BASIC, modified display for UK market.
Reviewed:- July '79

CHALLENGER, C2

CPU 6502
RAM 4K/32K
I/O SER PARA
CASS Kansas
BASIC 8K
Other NO
DISC OPT
m/c 2K
£349

Extras:- Disc, printer, memory.
Applications:- 4 slot backplane machine, upgraded system.

CHALLENGER, C4

CPU 6502
RAM 8K/32K
I/O SER PARA
CASS YES
BASIC 8K
Other NO
DISC OPT
m/c 4K
£395

Extras:- Disc, printers, etc.
Applications:- Upgraded C2 with colour graphics.

CHALLENGER, C8P

CPU 6502
RAM 8K/32K
I/O SER PARA
CASS YES
BASIC 8K
Other NO
DISC OPT
m/c 4K
£475

Extras:- Disc, printers, etc.
Applications:- Upgraded C2 with colour graphics.

CHALLENGER, C3

CPU 6502, 6800 + Z80
RAM 48K/58K
I/O Various
CASS N/A
BASIC YES
Other Various
DISC 2x8"
m/c DOS
£2,450

Extras:- VDU, printer, software
Applications:- Triple CPU system for business use etc.

Periflex

PERIFLEX 630/48
Dist:- Sintrom,
Arkwright Road, Reading,
Berks. RG2 0LS.
0734-85464.

CPU Z80
RAM 48K
I/O Various
CASS N/A
BASIC various
Other Various
DISC 2x5¼"
m/c CP/M2
£2,500

Extras:- VDU, printers, S100 board set.
Applications:- S100 based systems.

PERIFLEX 1024/64

CPU Z80
RAM 64K
I/O Various
CASS N/A
BASIC Various
Other Various
DISC 2x8"
m/c CP/M 2
£3,300

Extras:- VDU, printers.
Applications:- S100 based boxed computer.

Powerhouse

POWERHOUSE 2
Dist:- Powerhouse,
5 Alexandra Road,
Hemel Hempstead, Herts HP2 5BS.
0442-48422.

CPU Z80A
RAM 32K/64K
I/O SER PARA.P
CASS YES
BASIC Yes
Other No
DISC OPT
m/c 2K
£1,250

Extras:- Graphics, I/O, printer.
Applications:- 5'' VDU based system used in scientific and industrial control.

POWERHOUSE 3

CPU Z80A
RAM 32K/64K
I/O SER PARA.P
CASS N/A
BASIC Yes
Other Various
DISC 2x5¼"
m/c CP/M
£2,250-£2,750

Extras:- Graphics, I/O, printer.
Applications:- 9'' VDU based system with potential DP and small business applications.

Powertran

PSI COMP 80
Dist:- Powertran Electronics,
Portway Industrial Estate,
Andover, Hants SP10 3MN.
0264-64456.

CPU Z80
RAM 3K/32K
I/O Various
CASS Kansas
BASIC 2K
Other NO
DISC
m/c 1K
£255

Applications:- Mathematical/number crunching with special on-board chip.

Rair

BLACK BOX
Dist:- Rair Ltd.,
30-32 Neal Street,
London WC2H 9PS.
01-836 4663.

CPU 8085A
RAM 32K/64K

I/O SER
CASS N/A
BASIC Various
Other Various
DISC 2x5¼"
m/c CP/M
£2,500 upwards

Extras:- VDU's, printer, hard and floppy discs.
Applications:- Disc based professional system capable of handling up to 16 terminals.

Research Machines

RML 380Z
Dist:- Research Machines,
P.O. Box 75, Mill St.,
Oxford.
0865-49791.

CPU Z80A
RAM 16K/56K
I/O Various
CASS CUTS 300/1200 baud
BASIC YES
Other Various
DISC OPT
m/c 3K
£897 upwards

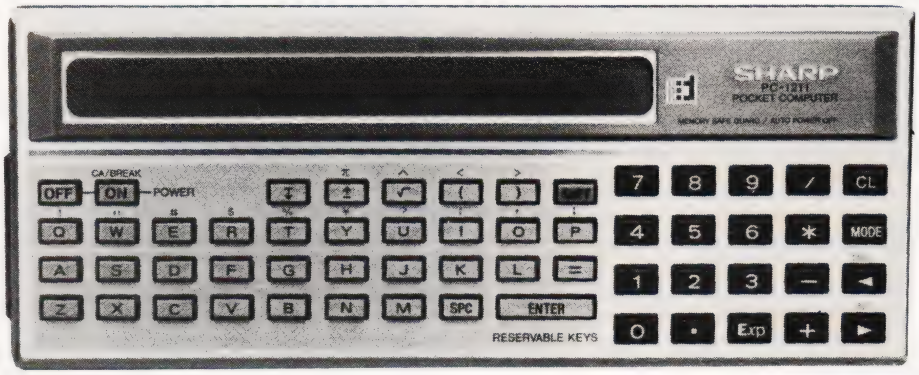
Extras:- Graphics, printer, etc.
Applications:- Educational system of high quality.

Rockwell

AIM 65
Dist:- Pelco Electronics,
Enterprise House, 83-85 Wester Road,
Hove, Sussex BN3 1UB.
0273-722155.
+ several regional outlets.

CPU 6502
RAM 1K/4K
I/O SER PARA
CASS 2
BASIC 8K Opt
Other
DISC
m/c 8K
£265 upwards

Extras:- Discs, RAM, VDU, cases, etc.
Applications:- Versatile single board with single line display and thermal printer.
Reviewed:- Dec '79



SGS Ates

NANOCOMPUTER
Dist:- Griffin & George,
Ealing Road, Wembley,
Middx HA0 1HJ.
01-997 3344

CPU	Z80
RAM	4K/16K
I/O	SER 2PARA
CASS	YES
BASIC	8K opt
Other	
DISC	
m/c	2K

£460 upwards for complete system

Extras:- Experimenter systems, full system capability.
Applications:- Educational single board that can grow to full system.
Reviewed:- Aug '79

Sinclair Research

ZX80
Dist:- Science of Cambridge,
6 Kings Parade,
Cambridge, Cambs CB2 1SN.
0223-311488.

CPU	Z80A
RAM	1K/16K
I/O	PARA BUS
CASS	YES
BASIC	YES
Other	NO
DISC	NO
m/c	

£80 kit, £100 built

Extras:- Kit or ready built, PSU, 16K RAM 8K BASIC
Applications:- Touch keyboard, low-cost beginners/educational system
Reviewed:- June '80

ZX81

CPU	Z80A
RAM	1K/16K
I/O	BUS
CASS	YES
BASIC	8K
Other	NO
DISC	NO
m/c	NO

£69.95

Extras:- 16K RAM, Printer (June)
Applications:- Upgraded version of ZX80, also available as a kit for £49.95.
Reviewed:- June '81

Sharp Electronics

MZ-80K
Dist:- Sharp UK Ltd.,
Thorn Road, Newton Heath,
Manchester M10 9BE.
061-205 2333.
+ growing regional network including Microdigital and Newbear.

CPU	Z80
RAM	6K/34K
I/O	PARA
CASS	YES
BASIC	14K
Other	
DISC	Opt
m/c	4K

£480 to £599

Extras:- Discs, printer, I/O adaptor
Applications:- Japanese desktop system expanding to business market.

PC 1211

CPU	2x4 bit Custom
RAM	Approx 1.5K
I/O	NO
CASS	OPT
BASIC	YES
Other	NO
DISC	NO
m/c	NO

£120 approx inc cassette adaptor

Extras:- Printer adaptor.
Applications:- 1424 step BASIC programmable handheld computer using LCD display.
Reviewed:- September '80

PC-3201

CPU	Z80A
RAM	64K
I/O	PARA.P
CASS	YES
BASIC	32K Extended
Other	—
DISC	OPT
m/c	—

£2,995 for complete system

Extras:- Twin 5¼" discs (568K) expandable to 8 drives, printer.
Applications:- Small business system with a commercially oriented version of BASIC.

Smoke Signal

SMOKE SIGNAL CHIEFTAIN
Dist:- Strumech,
Portland House, Coppice Side,
Brownhills, Walsall, West Midlands.
05433-4321.
+ Windrush.

CPU	6800
RAM	32K/56K
I/O	SER SS50 BUS
CASS	N/A
BASIC	YES
Other	Various
DISC	OPT
m/c	1K + DOS

£3,000

Extras:- Floppies, printers, VDUs.
Applications:- Mainly supplied to education and research although suitable for business.

Sord

M100 ACE Mk III
Dist:- Exleigh Business Machines Ltd.,
11 Market Place, Penzance,
Cornwall TR18 2JB.
0736-66577.
+ Midas Computer Services, 2 High Street,
Steyning, W Sussex BN4 3GG
0903-813913

CPU	Z80
RAM	48K
I/O	Various
CASS	N/A
BASIC	YES
Other	FORTRAN
DISC	2x5¼"
m/c	

£2,259

Extras:- More discs, Colour graphics
Applications:- Personal or small business machine from Japan based on the S100 bus.

M203 Mk III

CPU	Z80A
RAM	64K
I/O	Various
CASS	N/A
BASIC	YES
Other	Various
DISC	2x5¼"
m/c	CAP.BOS

£2,979

Extras:- 2 x 8" floppies, 2 more 5¼" floppies
Applications:- Process control, wordprocessing, business system with CAP/CPP software.

M223 Mk III

CPU	Z80A
RAM	64K
I/O	Various
CASS	N/A
BASIC	YES
Other	Various
DISC	2x5¼"
m/c	CAP.BOS

£3,489

Extras:- 4 x 8" floppies, more 5¼" floppies, up to 4 x 8 Mb Hard disc.
Applications:- As the M203 but with a full S100 bus to allow system expansion.

Southwest Technical Products

SWTP 6800/6809
Dist:- Southwest Technical,

38 Dover Street,
London W1X 3RB.
01-491 7507.

CPU 6800 or 6809
RAM 8K/56K
I/O Various
CASS YES
BASIC Various
Other Various
DISC OPT
m/c 2K

Extras:- Discs, printer, VDU.
Applications:- SS50 based system with good software support.

Tandy Corporation

TRS-80 Level 1 & 2
Dist:- Tandy Corporation,
Bilston Road, Wednesbury,
West Midlands WS10 7JN.
021-556 6101.
+ regional shops

CPU Z80
RAM 4K/48K
I/O OPT
CASS YES
BASIC 2 versions
Other FORTRAN
DISC OPT
m/c 4K
£380 - £560

Extras:- Discs, printers, I/O.
Applications:- Top selling system with "separates" approach.
Reviewed:- November '79

TRS-80 Model II

CPU Z80
RAM 32K/64K
I/O SER PARA
CASS N/A
BASIC YES
Other
DISC 8"
m/c
£2,000 upwards

Extras:- Printer, disc.
Applications:- Upgraded business version of Model I.

TRS-80 Model III

CPU Z80
RAM 4K/48K
I/O PARA
CASS 200/500 Baud
BASIC Level III
Other —
DISC OPT
m/c YES
£499 upwards

Extras:- All the Tandy range, RS232 port.
Applications:- Complete packaged version of popular TRS-80 range with enhanced BASIC.

POCKET COMPUTER

CPU 2x4-bit
RAM Approx 1.5K
I/O NO
CASS OPT
BASIC YES
Other NO
DISC NO
m/c NO
£119

Extras:- Cassette interface.
Applications:- Identical to Sharp PC1211.

Tangerine Computers

MICROTAN 65
Dist:- Tangerine Computers,
Forehill, Ely, Cambs.
0353-3633.
+ regional dealers

CPU 6502
RAM 1K/48K
I/O BUS
CASS OPT
BASIC OPT 10K
Other NO
DISC NO
m/c 1K
£69 upwards

Extras:- Tanex board for I/O, BASIC, etc + racking,cases.
Applications:- Machine code system, kit or built that expands to a full computer.
Reviewed:- June '80

MICRON

CPU 6502
RAM 8K/227K
I/O 1 SER, 4 PARA
CASS CUTS 300 or 1200 special
BASIC 10K Microsoft
Other NO
DISC NO
m/c 3K
£395 inc

Extras:- RAM, Discs, I/O rack system
Applications:- Cased built system with excellent expansion possibilities.
Reviewed:- October '80

Technalogics

TECS
Dist:- Technalogics,
8 Egerton St., Liverpool,
Merseyside L8 7LY.
051-724 2695.
+ 1 Regional Distributor.

CPU 6800
RAM 16K/56K
I/O SER PARA
CASS 2
BASIC 3K
Other YES
DISC OPT
m/c 4K

Extras:- Discs, RAM, Prestel Software
Applications:- Prestel editing terminal for IPs, could be used as a Teletext/Prestel based personal system.
Reviewed:- May '79

Texas Electronic Instruments

TEI 208-212
Dist:- Abacus,
62 New Cavendish Street,
London W1M 7LD.
01-580 8841.

CPU Choice
RAM 32K/60K
I/O PARA SER
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c CP/M
£3,535-4,497

Extras:- 8" discs (212) printers, hard disc soon
Applications:- Integral VDU models forming the basis of a business system.

Texas Instruments

TI 99/4
Dist:- Texas Instruments,
European Consumer Division,
Manton Lane, Bedford MK41 7PA.
0234-67466.

CPU 9900
RAM 16K
I/O PARA BUS
CASS 2
BASIC 14K
Other NO
DISC OPT
m/c 12K
£995

Extras:- Discs, speech synthesiser
Applications:- Colour graphics machine with "plug-in" software. Needs US TV, soon to change.

Transam

TRITON
Dist:- Transam,
59-61 Theobalds Road,
London WC1.
01-405 5240.

CPU 8080
RAM 1K/3K
I/O PARA BUS
CASS Kansas
BASIC Various
Other Pascal
DISC OPT
m/c Various monitors
£294 to £1,000

Extras:- Cases, Discs, Motherboard, Assembler package
Applications:- Versions available for most requirements, from educational to research.
Reviewed:- May '80

TUSCAN

CPU Z80
RAM 1K/8K
I/O SER PARA
CASS YES
BASIC OPT
Other Pascal
DISC OPT
m/c 2K
£195 upwards

Extras:- Casing, VDU option, discs, Firmware, S100 boards
Applications:- S100 based kit, development style system. Also ready built.

Transdata

Cx400
Dist:- Transdata Ltd.,
Battlebridge House, 87-95 Tooley Street,
London SE1.
01-403 5115

CPU 8080
RAM 16K/48K
I/O 4 SER, BUS
CASS —
BASIC YES
Other MICRO COBOL
DISC 8"
m/c Monitor
£1,450-2,750

Extras:- Multiple 8" drives.
Applications:- Multiprocessor architecture system for "front-ending".

Cx500

CPU Z80A
RAM 64K
I/O 4 SER, BUS
CASS —
BASIC Microsoft
Other Various
DISC 2 x 8" DS
m/c CP/M MP/M
From **£**3,500

Extras:- 20Mb Winchester ¼" magtape cartridge.
Applications:- Multiprocessor structured system for OEM market.

Vector Graphic

SYSTEM B
Dist:- Almarc Data Systems,
906 Woodborough Road,
Nottingham NG3 5QS
0602-625035.
+ regional dealers

CPU Z80
RAM 56K
I/O SER PARA
CASS N/A
BASIC Various
Other Various
DISC 2x5¼"
m/c CP/M 2
£3,200 upwards

Extras:- Printer, software, S100 boards
Applications:- Serious computing package complete with VDU and software.

VECTOR GRAPHIC 2800

CPU Z80
RAM 56K
I/O SER PARA
CASS N/A
BASIC Various
Other Various
DISC 2x8"
m/c CP/M 2
£4,195 upwards

Extras:- Printers, S100 boards, software
Applications:- Data processing and scientific/industrial computing. Terminal based system.

VECTOR GRAPHIC 3030

CPU Z80
RAM 56K
I/O SER PARA
CASS N/A
BASIC Various
Other Various
DISC 2x5¼" + 32Mb Hd
m/c CP/M 2
£TBA

Extras:- Printers, S100 boards, software.
Applications:- Hard disc based terminal system for DP.

VIP

CPU Z80A
RAM 56K
I/O 1 SER, 3 PARA
CASS —
BASIC —
Other —
DISC 5¼"
m/c CP/M
£2,125

Extras:- Vector Graphic range
Applications:- Complete system with single disc and VDU. Six slot S100 bus.

Video Genie

VIDEO GENIE
Dist:- Lowe Electronics,
Bentley Bridge, Chesterfield Road,
Matlock, Derbyshire DE4 LEF.
0629-2817.
+ dealer network.

CPU Z80
RAM 16K/48K
I/O PARA BUS
CASS YES
BASIC 10K
Other
DISC OPT
m/c 2K
£425 inc VAT

Extras:- Printer, discs via Tandy style expansion unit.
Applications:- HONG KONG copy of TRS-80 and which also runs Level 2 software. Now available with colour graphics.
Reviewed:- May '81

Xerox

DIABLO 3000
Dist:- Business Computers,
The Pagoda, Theobald Street, .
Borehamwood, Herts WD6 4RT.
01-207 3344.

CPU 8085
RAM 32K/64K
I/O SER
CASS N/A
BASIC YES
Other DACL
DISC 2x8"
m/c DOS
£8,950-**£**15,000

Extras:- Business software, Printer, Communications adapter
Applications:- Complete business system that can be multi-tasked. Price includes software.

DIABLO RANGER 3200

CPU 8080
RAM 32K/64K
I/O SER
CASS N/A
BASIC YES
Other DACL
DISC 2x8"
m/c DOS
£10,865-**£**50,000

Extras:- Up to 4 discs, Up to 2 hard discs, Printers, Communications adapter.
Applications:- Complete system that can run up to eight jobs simultaneously, price includes software.

Zenith Data Systems

ZENITH Z89
Dist:- Zenith Data Systems,
Heath Electronics, Bristol Road,
Gloucester GL2 6EE.
0452-29451.
+ London shop 01-636 7349.

CPU Z80
RAM 16K/64K
I/O SER
CASS OPT (H88)
BASIC YES
Other Various
DISC 5¼"
m/c CP/M, HDOS
£1,570 upwards

Extras:- Dual 8" discs, printer
Applications:- Integrated system of very high quality, also available as a kit.
Reviewed:- June '80

ZENITH Z11

CPU LSI 11
RAM 16K/32K
I/O Various
CASS N/A
BASIC YES
Other Various
DISC OPT2x8"
m/c N/A
£1,250

Extras:- Discs, printer, VDU
Applications:- LSI 11 compatible 16 bit system.

ZX80-ZX81
HARDWARE

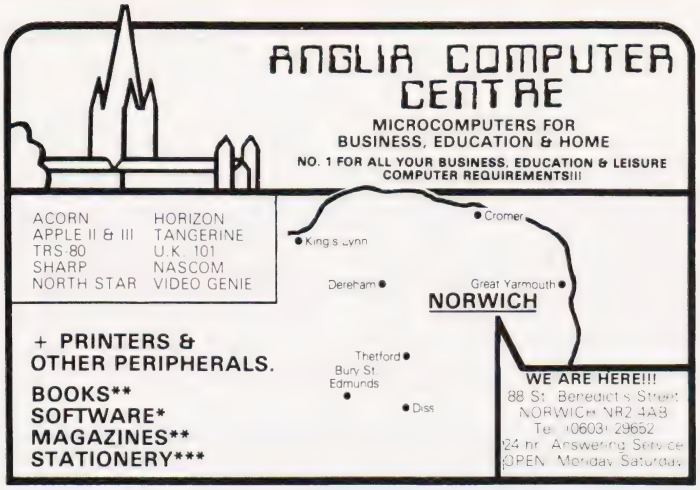
1. Keyboard Sounders
Every keyboard entry gives you a short audible bleep. KS1 for ZX80 £15. KS2 for ZX81 £14.

2. Tape Recorder Interface
Gives adequate level for loading from any cassette machine. TR1 for ZX80/81 £10.

3. Video units which drive standard 1 volt monitors. VU1 for ZX80, ZX81 £10.

ALL UNITS SELF CONTAINED, COMPLETE WITH LEADS AND DIAGRAMS. CONNECTIONS ONLY TAKE A FEW MINUTES.

D. BRUCE ELECTRONICS
The Beacon, Blackhall Rocks,
Cleveland TS27 4BH.
Tel. 0783-863612



Sinclair ZX81
MULTIFILE

An amazingly versatile multi-purpose filing system for the 16K ZX81. The program is menu driven, and files are user-definable. Both string & numerical files are catered for. Create, delete, replace, search commands, foolproof file security, printer output, & many more features. Comes on cassette, complete with 3 data cassettes for file storage, and comprehensive documentation describing a host of applications for both business & personal use.

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251 HENLEY ROAD, COVENTRY, CV2 1BX

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Control Technology,
39 Gloucester Road,
Gee Cross, Hyde,
Greater Manchester SK14 5JG.

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NORTHERN MICRO , 29 Moorcroft Park, New Mill, HUDDERSFIELD
Tel. Holmfirst (048489) 2062. SAE for list please. Kits despatched within 72hrs!

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London WC2H 0EE

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Backnumbers issue list

July 1980
Battle of Britain simulation, Multiple choice exam program, Address list program, Kingdoms game.

August 1980
Multipurpose records program, Conlan language, Floppy discs examined, Systematic programming theory.

September 1980
Pascal overview, PC 1211 reviewed, BASIC dialects, Othello and Ski Run programs.

March 1981
SuperPET review, 6502 programming course, Boolean algebra on micros, Golf simulation.

May 1981
Colour Video Genie review, Programming languages, ZX80 books surveyed, Everest game program, Multipurpose interface.

June 1981
Sinclair's ZX81 reviewed, Versatile A to D converter project, The BBC's software specification, CT's programming standards.

A very limited number of copies of May and October 1980 are available in addition to the above. Last month's issue is still available as well but has not yet reached the end of its 'shelflife' and is not included for this reason.

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The PIC-CHIP.... a powerful easy-to-use graphics facility for all New Rom PETs.

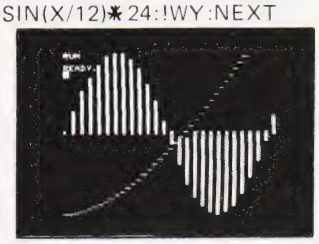
The PicChip is a ROM module which simply plugs into your PET making available immediately over forty new BASIC commands. These commands use BASIC variables as parameters (no PEEKing or POKEing) and enable the graphic possibilities of the PET to be fully exploited - even by beginners! Using an X, Y coordinate system based on an origin specified by program, lines, graphs and drawings of all kinds can be generated on the screen by simple programming. Other commands enable defined areas, or the whole of the screen, to be rolled or shifted up, down, left and right. Images can be stored to and retrieved from any RAM address.

Originally designed for **scientific** and **technical** applications, the PicChip is also being used in **educational projects, games** and **design work** of all kinds. The combination of fast plotting and area manipulation makes the PicChip ideal for the continuous display of real-time data in graphical form.

Just see how easy it is to use PicChip commands: the following examples were all photographed directly from a PET screen.

Picture 1 shows two curves, one drawn in fine-density and one in bar form, produced by two program lines:

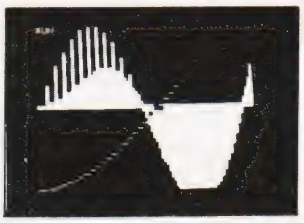
```
10 FOR X=0 TO 39:Y = X↑1.5:!WF:
NEXT
20 Y0=25:FOR X=0TO79 STEP 3:
Y=SIN(X/12)*24:!WY:NEXT
```



(1)

Picture 2 adds a third program line to plot a function as adjacent bars:

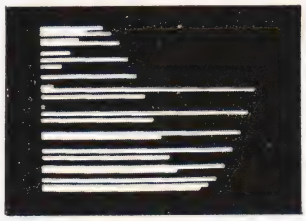
```
30 FOR X = 0 TO 79:Y=SIN(X/12)*
X/2:!WY:NEXT
```



(2)

If we just take the second program line and change !WY to !WX, the bars are plotted horizontally:

```
20 FOR X = 0 TO 79:Y=SIN(X/12)*24:
!WX:NEXT
```

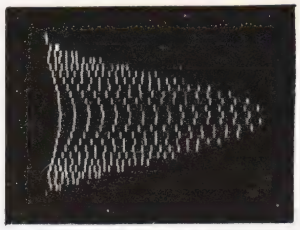


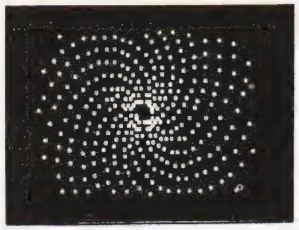
(3)

All the other pictures reproduced here were generated by the DEMONSTRATION PROGRAM included in the 20-page Handbook. What we can't show here are the amazing effects produced by shifting or rolling or otherwise manipulating different areas of the screen. There is even a repeat-key function, and commands for reading and setting the cursor position in X,Y co-ordinates.

PicChip Functions.

Command	Function
SYS 45056	PicChip On
!RE	Restore screen
!CO	PicChip off
!RP	Repeat-Key on
!RO	Repeat-Key off
!CW	Cursor-position Write
!CR	Cursor-position Read
!AF	Area Fill
!AR	Area Reverse
!AN	Area Normal
!AI	Area Invert
!AS	Area in Shift case
!AU	Area in Unshift case
!AC	Area Case invert
!AF	Screen Fill
!SR	Screen Reverse
!SN	Screen Normal
!SI	Screen Invert
!SS	Screen in Shift case
!SU	Screen in Unshift case
!SC	Screen Case invert
!US	Up Shift
!DS	Down Shift
!LS	Left Shift
!RS	Right Shift
!UR	Up Roll
!DR	Down Roll
!LR	Left Roll
!RR	Right Roll
!WP	Write Point
!EP	Erase Point
!WL	Write Line
!EL	Erase Line
!WC	Write Continuous line
!EC	Erase Continuous line
!WX	Write bar in X axis
!EX	Erase bar in X axis
!WY	Write bar in Y axis
!EY	Erase bar in Y axis
!WF	Write fine Y
!EF	Erase fine Y
!FW	Write fine X
!FE	Erase fine X
!CS	Copy Screen
!PC	Poke Character





The standard PicChip plugs into socket UD4 of the PET, but is also available to fit either of the other two sockets. PicChip is therefore **compatible with other PET ROM packages.** Installation and use are fully described in the handbook.

The PicChip costs £45 + VAT. To buy the handbook separately costs £5 but this may be offset against an eventual purchase of the chip. State required socket when ordering. **10% discount to educational institutions.**

Basic IV and 8000 Series version available.

Mail Order to:–

Insel Computer Ltd.,
7 Bramshill Mansions,
Dartmouth Park Hill,
London N.W.5.

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MICROTAN 65 Plus Tangerine power supply for sale £70 ono. Phone PAL Coventry 661297 after 5pm.

NASCOM 1/2 Assemblers NAS-SYS: 5.7K cassette £12: 8.5K D-DOS £15: 2K position independent debug £8.50: D-DOS card index/catalogue program 3K(MC/G) £15: 5.5K Hybrid Basic £3.00 (not sold separately). Details SAE P.Watson 101 Village Road, Bromham, Bedford MK43 8HU (Oakley 2867).

ZX80/81 USER DEFINABLE GRAPHICS circuit details £2. keyboard bleeper circuit £1. ZX81 graph-plot program £1. M. Caldon 9 Caistersands Avenue, Caister, Norfolk.

MK14 KITS. We have 50 items for Mk14 computers. Send SAE for price list. 20 page catalogue 90p plus 25p post. Redditch Electronics, 21 Ferney Hill Avenue, Redditch, Worcestershire, B97 4RU. Tel. 0527 61240 evenings.

PRINTER for Nascom 1-2. Creed teleprinter fitted with interface. With software + paper. Plug on and print! £45 Telephone (01) 997 4527.

AT LAST! Microtan 65 'Adventure' — m/c. 7K — £5.50. Many other m/c. Basic programs. SAE for lists. I. Dickinson, 1, The Hemplands, Chedworth, Cheltenham, Glos.

RADIOFIN programmable game with ten cartridges including Space Invaders and programmable chip compatible with Acetronic and Princetronic cartridges. Cost new £270. Ring 068688502.

PRINTER TERMINAL, 110 Baud Olivetti TE300, RS232 serial interface, paper tape punch, paper tape reader (needs attention), stand, manual, paper. £99. Watford 34560.

48K TRS-80 with disc. New ROMs, green video. Value £1200+, offers around £800 in writing to: N.Rushton, 123 Roughwood Drive, Northwood, Kirkby, Merseyside L33 9UG.

NASCOM IMP ASCII matrix printer; Carter ASCII keyboard (uncased) plus numerical keypad; Acorn system one micro with Hex keyboard, Hex LCD display, interface, etc. Original cost £550. Unused. Offers — Southport (0704) 79312.

CENTRONICS MICROPRINTER P1. Five rolls of paper included. £170 (165 you collect). 068-45-4930 evenings and weekends.

KEYBOARD FOR ZX81. Build up our full size keyboard for your ZX80 or ZX81. Kit 19.95 + p. & p. In/out port to control up to 24 lines £14.95. Edge connector £3.95. P. & p. 95p. SAE for price list and details. Redditch Electronics, 21 Ferney Hill Avenue, Redditch, Worcestershire, B97 4RU. Tel. 0527 61240 evenings.

UK101 8K CASED with tape rec. Newmon Cegmon with toolkit 300/600 baud 1/2 MbHertz. Lots of software £280 negotiable. Stevenage 69612 after 6pm.

UK101 & SPRBD SOFTWARE (TAPES). 8K: Lunar Lander*, X-Wing Fighers*, Space Invaders*, Chess Set (2 player). Startrek, Zombie, Biorhythm (printer necessary). Three Dimensional Maze. 4K: Digiclock (Big H/M/S)*, Hangman. 16x48 and 25x25 displays only. GOOD GRAPHICS! *=real-time! 350p each from K A SPENCER, 74 DOVERS PARK, BATHFORD, NEAR BATH.

SIXTY ZX81/80 PROGRAMS. Specify which, listings only £4.95 Barclaycard accepted. Includes many games, Utility programs, Home Finance, Maths, Chequebook, plus more in our 'ZX81/80 Programs'. Includes Hints'N'Tips, from Sussex Software, Wallsend House, Pevensey Bay, Sussex.

PROFIT FROM COMPUTERS Full or part time, little or no capital needed, any area. SAE for details, Sussex Software, Wallsend House, Pevensey Bay, Sussex.

MICRO COMPUTER (Ohio Superboard) 6502. 8K Basic in ROM, 2K monitor, 4K RAM. Full keyboard, 12" VDU. As new. Tape recorder. £380. Tel. 01-579 7776.

PARANOID SOFTWARE present PARASOFT — a multiplicity of really hoopy software for all sizes of ACORN ATOM and SINCLAIR ZX81. Send S.A.E. for free catalogue and price list to: PARANOID SOFTWARE, 17A Granville Rd., Walmer, Deal, Kent.

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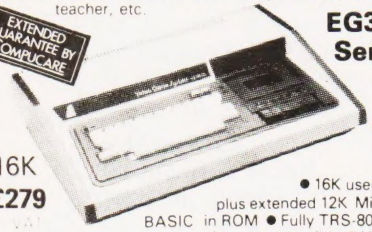

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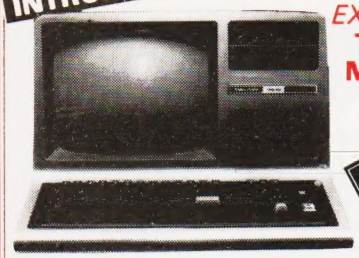

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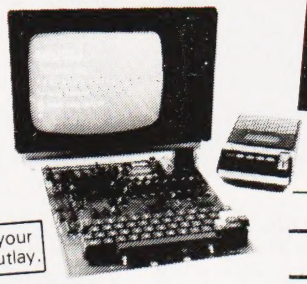

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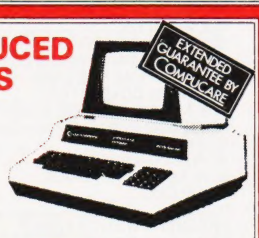

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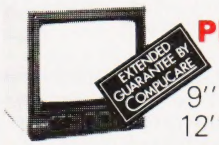

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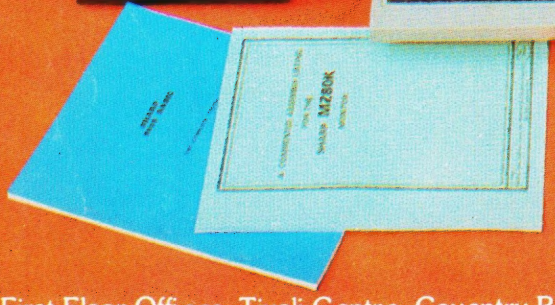

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